DEIF A/S

Designers Reference Handbook

Automatic Gen-set Controller
multi-line 2

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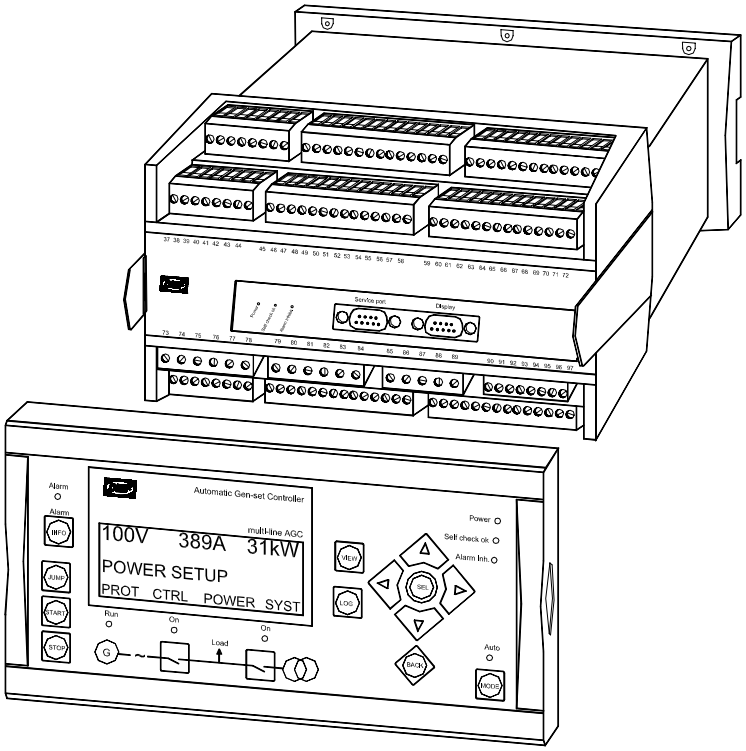

- *Getting started*
- *Modbus protocol*
- *Profibus protocol*
- *Caterpillar® CCM protocol*

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This document is a designers reference handbook for the DEIF multi-line 2 Automatic Gen-set Controller.

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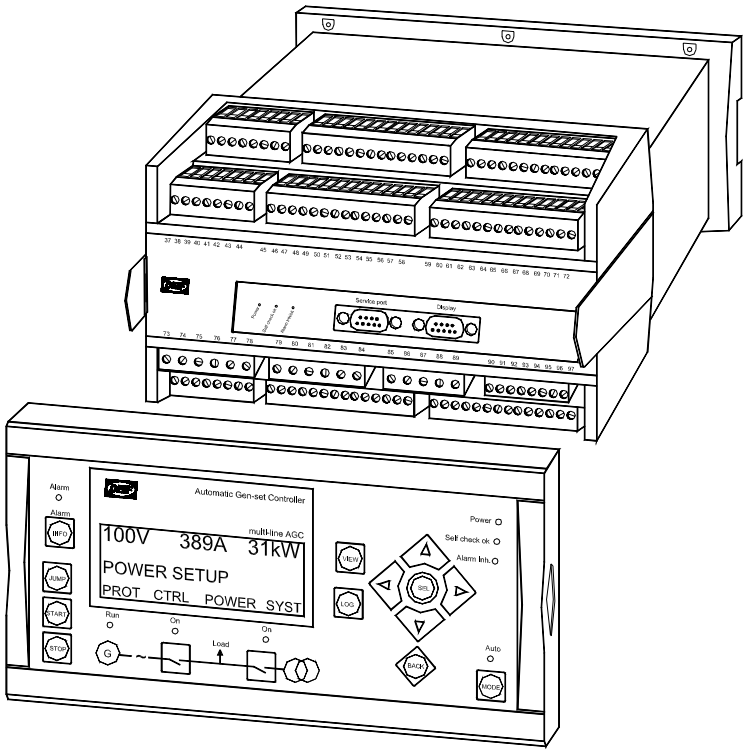
1 Getting started



- *Automatic mains failure*
- *Engine control*
- *Generator synchronisation*
- *Load control*
- *Generator protection*
- *Remote control (via www)*

1.1 Warnings and legal information

This manual gives guidelines to the use and installation of the DEIF multi-line 2 automatic gen-set controller. It is, however, not a complete installation instruction. Therefore, even if terminal numbers are shown in the drawings, the drawings are to be used as guidance only.

Installing and operating the multi-line 2 AGC product implies work with dangerous currents and voltages, and therefore qualified personnel should do it only.

Care must be taken during the installation to protect the terminals against static discharges. Once the units are installed and connected, these precautions are no longer necessary.

DEIF takes no responsibility for operation or installation of the generator set. If there is any doubt about how to install or operate the system on which the multi-line 2 AGC product is measuring, the company responsible for the installation or the operation must be contacted.

1.2 Standard functions

The multi-line 2 AGC is a protection and control unit for a generator driven by a diesel engine. It will carry out all necessary tasks to control and protect a gen-set, regardless of the use of the generator. This means that the multi-line 2 AGC can be used for several application types such as:

- Stand-alone gen-set
- Gen-set in island operation, load sharing
- Automatic mains failure with starting of the gen-set. No back synchronising when the mains returns
- Automatic mains failure with starting of the gen-set and back synchronising when the mains returns
- Gen-set in parallel with mains in fixed load mode
- Gen-set in parallel with mains in peak shaving mode

The selection of the application type is done in the system setup. The AGC is only intended to be configured to one of the above application types. It is possible to operate the AGC in three modes:

- Auto (only AMF and peak shaving mode – the AGC controls the gen-set and the breakers according to the operational state)
- Semi-auto (manual control and activation of the sequences)
- Test (manual starting and loading of the gen-set)

The multi-line 2 measuring system is true RMS 3-phase measurement of generator voltage, generator current and mains voltage.

1.2.1 Language

English, German, French or Spanish language can be chosen via the system menu structure.

1.2.2 Standard functions

The AGC has the following control and protection functions:

- Engine protection. The engine alarm extension card has the following configurable inputs and outputs:
  - 4 4…20 mA inputs
  - 1 tacho input
  - 1 binary input
  - 2 PT100 inputs

- AMF functions, Automatic Mains Failure with engine start/stop logic
  - Automatic starting of the gen-set
  - Operation of the mains and generator breaker
  - Back synchronising of the gen-set to mains when the mains returns
  - Stopping of the gen-set

- Peak shaving with engine start/stop logic
  - Automatic starting of the gen-set
  - Operation of the mains and generator breaker
  - Load control
  - Stopping of the gen-set

- Fixed mains power export
  - Controlled start/stop of the gen-set
  - Operation of the mains and generator breaker
  - Load control

- Island mode
  - Semi-auto operation
  - Operation of the generator breaker

- Fixed power
  - Semi-auto operation
  - Operation of the mains and generator breaker

- Test running
  - Automatic start-up and loading
  - Programmable load and running time

- Synchronising/back synchronising of the generator to mains
  - Dynamic synchronising with programmable slip frequency
  - Static synchronising, no slip frequency

- Overcurrent protection, definite time characteristic

- Reverse power protection, definite time characteristic

1.3 Optional function list

For available options of the AGC – please see Specification of options, document no. 4921240240.

1.4 Hardware

The multi-line 2 housing is divided into board slot positions, some of which are standard (non-changeable) and some intended for options. The unit is divided like this:

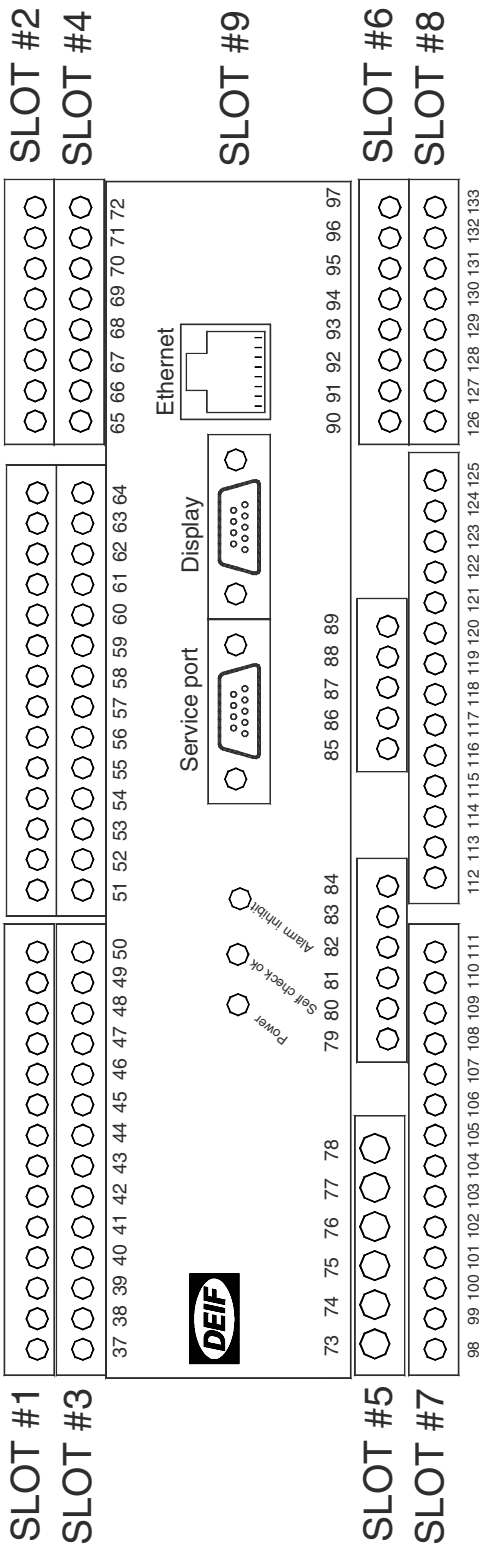
Slot	Slot type	Terminal	AGC
Slot #1	Power supply and binary I/O	1-28	Standard
Slot #2	External communication	29-36	Option H1, H2, H3
Slot #3	Load sharing control/I/O card	37-64	Option G3, M12
Slot #4	Governor control relay outputs*	65-72	Standard
Slot #5	AC measuring	73-89	Standard
Slot #6	Options PCB	90-97	Option F1, M13, M14, M15
Slot #7	Engine interface card	98-125	Standard
Slot #8	Internal communication	126-133	Option G4, H4
Slot #9	TCP/IP	RJ45 conn.	Option N1

* If analogue governor outputs (option E) or PWM outputs (option EF3) are selected, the standard relay output PCB in slot #4 is exchanged to the analogue PCB.

Besides the slots there is an additional board where the communication ports are placed. I.e. RS232 PC service port for the utility software and the display port.

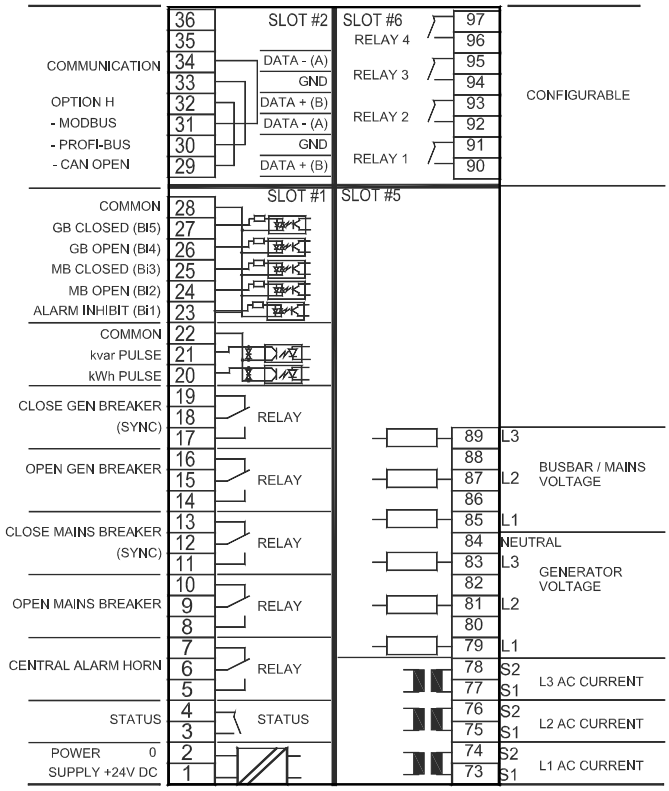
For slots #1, #2, #3, #5, #7, #8 and #9: Only specific boards can be mounted.
For slots #4 and #6: The boards are interchangeable.

An overview of the terminals can be seen on the next page. The slots are positioned in the unit as follows (seen from the top of the unit):

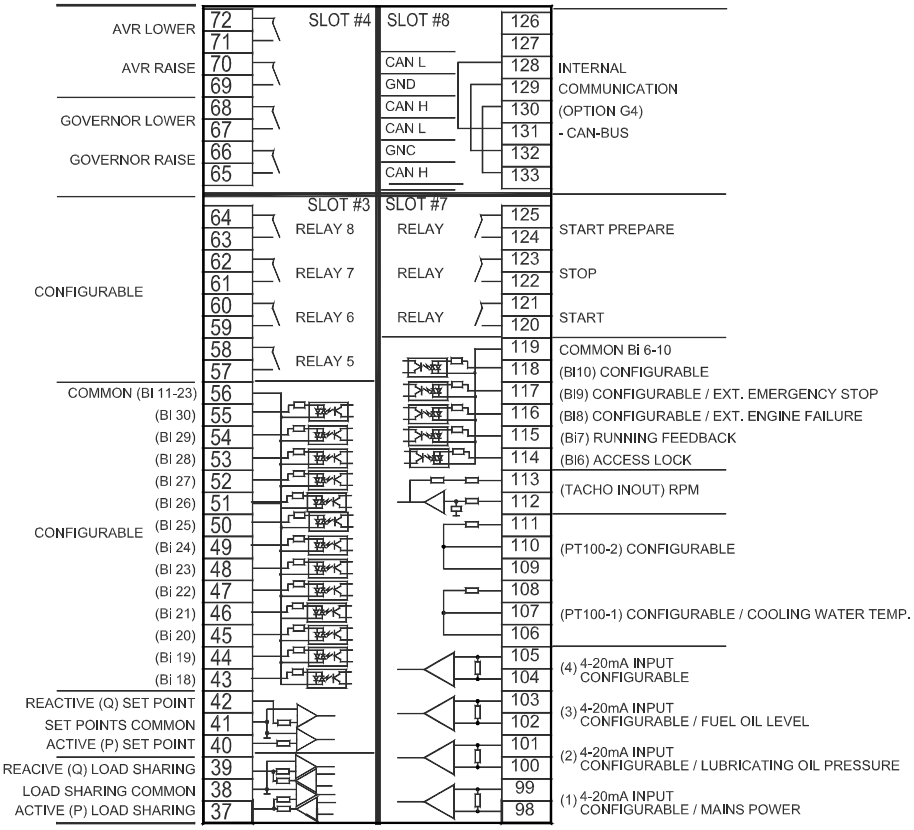

SLOT #1
SLOT #3
SLOT #5
SLOT #7
SLOT #2
SLOT #4
SLOT #9
SLOT #6
SLOT #8
Service port
Display
Ethernet
Power
Self check ok
Alarm inhibit

1.5 Terminal strip overview

1.5.1 Slots #1, #2, #5 and #6



1.5.2 Slots #3, #4, #7 and #8



1.6 Terminal strip, explanation

For the relay outputs the following terms will be used:

NO means **N**ormally **O**pen
NC means **N**ormally **C**losed
Com. means common terminal for the relay in question

1.6.1 Slot #1, power supply and binary I/O

Standard board (always needed):

Term.	Function	Technical data	Description
1	+12/24 VDC	12/24 VDC +/-25%	Power supply
2	0 VDC		
3	NC	Status relay 24 VDC/1A	Normally closed relay, processor/power supply status supervision
4	Com.		
5	NO	Relay 250 VAC/8A	Central alarm HORN
6	Com.		
7	NC		
8	NO	Relay 250 VAC/8A	Open mains breaker (open breaker)
9	Com.		
10	NC		
11	NO	Relay 250 VAC/8A	Close mains breaker (synchronising)
12	Com.		
13	NC		
14	NO	Relay 250 VAC/8A	Open generator breaker (deload)
15	Com.		
16	NC		
17	NO	Relay 250 VAC/8A	Close generator breaker (synchronising)
18	Com.		
19	NC		
20	Open collector 1	Transistor out	Pulse output 1, kWh counter
21	Open collector 2	Transistor out	Pulse output 2, kvarh counter
22	Com.	Common	Common terminal for terminals 20 and 21
23	Digital input 1	Optocoupler	Alarm inhibit
24	Digital input 2	Optocoupler	Mains breaker open
25	Digital input 3	Optocoupler	Mains breaker closed
26	Digital input 4	Optocoupler	Generator breaker open
27	Digital input 5	Optocoupler	Generator breaker closed
28	Com.	Common	Common for terminals 23 to 27

The auxiliary supply must be protected with a 1A fuse.

The functionality of the alarm inhibit input is described in the table below:

AGC		
Alarm inhibit input	**ON**	**OFF**
Generator low f	-	ACT
Generator low U	-	ACT
Generator high f	ACT	ACT
Generator high U	ACT	ACT
4…20 mA input	-	ACT
Binary input	-	ACT
PT100 input	-	ACT
Tacho input	-	ACT

ACT = Alarm function is active.

NOTE:
These inputs are not inhibited:

- Tacho input
- Emergency stop
- Running feedback
- Remove starter (if configured)

1.6.2 Slot #2, serial communication (option H)

1.6.2.1 Can-open (option H1 - not available at the moment)

Term.	Function	Description
29	Can-H	The can is based on can-open
30	GND	
31	Can-L	
32	Can-H	
33	GND	
34	Can-L	
35	Not used	
36	Not used	

1.6.2.2 Mod-bus (option H2)

Term.	Function	Description
29	DATA + (A)	Mod-bus RTU, RS485
30	GND	
31	DATA - (B)	
32	DATA + (A)	
33	GND	
34	DATA - (B)	
35	Not used	
36	Not used	

1.6.2.3 Profi-bus (option H3)

Term.	Function	Description
29	DATA + (B)	Pin 3 on 9 pole sub-D connector
30	GND	Pin 5 on 9 pole sub-D connector
31	DATA - (A)	Pin 8 on 9 pole sub-D connector
32	DATA + (B)	
33	GND	
34	DATA - (A)	
35	Not used	
36	Not used	

The serial communication line should be terminated between DATA + and DATA - with a resistor equal to the cable impedance. The terminals 29/32, 30/33 and 31/34 are internally connected on all communication PCBs.

Use shielded twisted pair cable.

1.6.3 Slot #3, load sharing control (option G3)

Term.	Function	Technical data	Description
37	-5…0…5 VDC	Analogue I/O	Active load sharing line
38	Com.	Common	Common for load sharing lines
39	-5…0…5 VDC	Analogue I/O	Reactive load sharing
40			
41			
42			
43			
44			
45			
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64			

1.6.4 Slot #3, 13 binary inputs and 4 relay outputs (option M12)

Term.	Function	Technical data	Description
37			
38			
39			
40			
41			
42			
43	Binary input 18	Optocoupler	Configurable
44	Binary input 19	Optocoupler	Configurable
45	Binary input 20	Optocoupler	Configurable
46	Binary input 21	Optocoupler	Configurable
47	Binary input 22	Optocoupler	Configurable
48	Binary input 23	Optocoupler	Configurable
49	Binary input 24	Optocoupler	Configurable
50	Binary input 25	Optocoupler	Configurable
51	Binary input 26	Optocoupler	Configurable
52	Binary input 27	Optocoupler	Configurable
53	Binary input 28	Optocoupler	Configurable
54	Binary input 29	Optocoupler	Configurable
55	Binary input 30	Optocoupler	Configurable
56	Com.	Common	Common for terminals 43 to 55
57	NO	Relay 5	Configurable
58	Com.	250 VAC/8A	
59	NO	Relay 6	Configurable
60	Com.	250 VAC/8A	
61	NO	Relay 7	Configurable
62	Com.	250 VAC/8A	
63	NO	Relay 8	Configurable
64	Com.	250 VAC/8A	

1.6.5 Slot #4, governor and AVR control relay outputs

Term.	Function	Technical data	Description
65	NO	Relay	Generator GOV: Increase frequency
66	Com.	250 VAC/8A	
67	NO	Relay	Generator GOV: Decrease frequency
68	Com.	250 VAC/8A	
69	NO	Relay	Generator AVR: Increase voltage
70	Com.	250 VAC/8A	
71	NO	Relay	Generator AVR: Decrease voltage
72	Com.	250 VAC/8A	

1.6.6 Slot #4, analogue outputs for governor and AVR control (option E)

Term.	Function	Description
65	Not used	
66	+/-20 mA out	Speed governor set-point output
67	0	
68	Not used	
69	Not used	
70	+/-20 mA out	AVR voltage set-point output
71	0	
72	Not used	

The analogue current outputs can, if needed, be converted to voltage using a resistor across the terminals (250 Ω will convert the +/-20 mA into +/-5 VDC).

1.6.7 Slot #4, analogue output for governor and one transducer output (option EF2)

Term.	Function	Description
65	Not used	
66	+/-20 mA	Speed governor set-point output
67	0	
68	Not used	
69	Not used	
70	0(4) - 20 mA out	1
71	0	
72	Not used	

1.6.8 Slot #4, PWM output (option EF3 and option D)

Term.	Function	Description
65	ANA +	Analogue +/-20 mA for AVR
66	ANA -	
67	PWM +	PWM speed governor signal
68	PWM -	
69	Relay 13	Relay output for AVR. Raise voltage
70	Relay 13	
71	Relay 14	Relay output for AVR. Lower voltage
72	Relay 14	

1.6.9 Slot #4, PWM output (option EF3 and not option D)

Term.	Function	Description
65	NC	
66	NC	
67	PWM +	PWM speed governor signal
68	PWM -	
69	NC	
70	NC	
71	NC	
72	NC	

The PWM signal has a frequency of 500 +/-50Hz, and the resolution of the duty cycle is 12 bits which gives the output 4095 different levels. The output is an open collector with a 1kΩ pull-up resistor. The low level of the signal is between 0 and 0.05 volt, and the high level is between 5.7 and 6 volt. The PWM droop signal is placed in slot #6.

1.6.10 Slot #4, governor/AVR output (option EF4)

Term.	Function	Description
65	ANA +	Analogue +/-20 mA for GOV
66	ANA -	
67	NC	
68	NC	
69	Relay 13	Relay output for AVR. Raise voltage
70	Relay 13	
71	Relay 14	Relay output for AVR. Lower voltage
72	Relay 14	

Term.	Function	Description
65	ANA +	Analogue +/-20 mA for AVR
66	ANA -	
67	NC	
68	NC	
69	Relay 13	Relay output for GOV. Increase frequency
70	Relay 13	
71	Relay 14	Relay output for GOV. Decrease frequency
72	Relay 14	

The two configuration combinations shown above in option EF4 are chosen in channel 2210.

1.6.11 Slot #5, AC measuring

Term.	Function	Technical data	Description
73	I L1 s1	Generator current L1	1/5 A AC input
74	I L1 s2		
75	I L2 s1	Generator current L2	1/5 A AC input
76	I L2 s2		
77	I L3 s1	Generator current L3	1/5 A AC input
78	I L3 s2		
79	U L1	Generator voltage L1	Max. 690 VAC phase - phase value
80		Not used	
81	U L2	Generator voltage L2	Max. 690 VAC phase - phase value
82		Not used	
83	U L3	Generator voltage L3	Max. 690 VAC phase - phase value
84	U neutral	Generator voltage neutral	
85	U L1	Mains/bus voltage L1	Max. 690 VAC phase - phase value
86		Not used	
87	U L2	Mains/bus voltage L2	Max. 690 VAC phase - phase value
88		Not used	
89	U L3	Mains/bus voltage L3	Max. 690 VAC phase - phase value

NOTE:
Current inputs are galvanically separated. Max. 0.3 VA per phase.

Voltage measurements are available in 4 levels:

1) 100 to 110 VAC (phase to phase)
2) 200 to 240 VAC (phase to phase)
3) 380 to 480 VAC (phase to phase)
4) 660 to 690 VAC (phase to phase)

The voltage level is to be defined when ordering.

1.6.12 Slot #6, optional I/O PCBs

It is only possible to install one of the optional cards in slot #6.

1.6.12.1 Option M13, 7 binary inputs

Term.	Function	Technical data	Description
90	Com.	Common	Common for terminals 91-97
91	Binary input 17	Optocoupler	Configurable
92	Binary input 16	Optocoupler	Configurable
93	Binary input 15	Optocoupler	Configurable
94	Binary input 14	Optocoupler	Configurable
95	Binary input 13	Optocoupler	Configurable
96	Binary input 12	Optocoupler	Configurable
97	Binary input 11	Optocoupler	Configurable

1.6.12.2 Option M14, 4 relay outputs

Term.	Function	Technical data	Description
90	NO	Relay 1	Configurable
91	Com.	250 VAC/8A	
92	NO	Relay 2	Configurable
93	Com.	250 VAC/8A	
94	NO	Relay 3	Configurable
95	Com.	250 VAC/8A	
96	NO	Relay 4	Configurable
97	Com.	250 VAC/8A	

1.6.12.3 Option M15, 4 analogue inputs 4...20 mA

Term.	Function	Technical data	Description
90	Analogue input 5 -	Common	4...20 mA input, configurable
91	Analogue input 5 +	4...20 mA in	
92	Analogue input 6 -	Common	4...20 mA input, configurable
93	Analogue input 6 +	4...20 mA in	
94	Analogue input 7 -	Common	4...20 mA input, configurable
95	Analogue input 7 +	4...20 mA in	
96	Analogue input 8 -	Common	4...20 mA input, configurable
97	Analogue input 8 +	4...20 mA in	

1.6.12.4 Option F1, analogue transducer output

These outputs are **active** outputs i.e. they use the internal power supply. The outputs are galvanically separated from each other and the rest of the AGC unit. The individual output can be selected (in display or via utility software) to represent any AC measuring value or related values (e.g. power, power factor, frequency etc.).

For actual selection refer to the channel number 4500-4560.

Via software selection the outputs can be selected to be 0…20 mA or 4…20 mA.

Term.	Function	Description
90	Not used	
91	0	Analogue output 1, selectable
92	0(4) - 20 mA out	
93	Not used	
94	Not used	
95	0	Analogue output 2, selectable
96	0(4) - 20 mA out	
97	Not used	

1.6.12.5 Option EF3, droop output

(Refer to speed output slot #4).

Term.	Function	Description
90		Not used
91		
92	PWM	PWM droop signal
93	PWM	
94		Not used
95		
96		Not used
97		

1.6.13 Slot #7, engine interface card

1.6.13.1 Standard card with PT100 inputs

The engine interface board is installed in slot #7. It consists of configurable inputs and relay outputs. The configuration is done through the utility software and the default settings can be changed to the relevant settings. To configure the inputs, upload the parameter list from the multi-line 2 and select the input to be configured. Then a configuration dialog box appears and the settings can be changed. The standard title (e.g. 4...20 mA in no. 3) can be changed and the new title will also be shown in the display.

The minimum and maximum values of the 4...20 mA input can be adjusted:

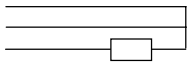
- Value: Alarm value (e.g. 85°C)
- Min.: Value corresponding to 4 mA (e.g. 0°C)
- Max.: Value corresponding to 20 mA (e.g. 100°C)

The inputs can be used for a high or low alarm. As a “high alarm” the alarm appears when the measured value is higher than the alarm limit, and as a “low alarm” the alarm appears when the measured values are lower than the alarm limit.

The relay outputs on slot #7 are used for engine control.

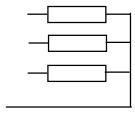
- Start
- Stop solenoid
- Start prepare

The binary inputs use 24 volt constant signal. They do not use pulse inputs.

Term.	Function	Technical data	Description/preconfiguration
98	Analogue input 1 +	+4…20 mA in	4…20 mA input/mains power - peak shaving, configurable
99	Analogue input 1 -	GND	
100	Analogue input 2 +	+4…20 mA in	4…20 mA input/lubricating oil pressure, configurable
101	Analogue input 2 -	GND	
102	Analogue input 3 +	+4…20 mA in	4…20 mA input/fuel oil level, configurable
103	Analogue input 3 -	GND	
104	Analogue input 4 +	+4…20 mA in	4…20 mA input/configurable
105	Analogue input 4 -	GND	
106	PT100 input 1 P		3-wire PT100 input/cooling water temp./configurable -40…+250°C According to EN 60751 and IEC 751
107	PT100 input 1 I		
108	PT100 input 1 O		
109	PT100 input 2 P		3-wire PT100 input/configurable -40…+250°C According to EN 60751 and IEC 751
110	PT100 input 2 I		
111	PT100 input 2 O		
112	Tacho input	0.5…70 VAC /10…10.000 Hz	RPM/magnetic pickup/overspeed
113	Tacho input		
114	Binary input 6	Optocoupler	Access lock, not configurable
115	Binary input 7	Optocoupler	Running feedback, not configurable
116	Binary input 8	Optocoupler	External engine failure, text configurable
117	Binary input 9	Optocoupler	External emergency stop activated, text configurable
118	Binary input 10	Optocoupler	Configurable
119	Com.	Common	Common for terminals 114-118
120	NO	Relay 250 VAC/8A	Start/crank
121	Com.		
122	NO	Relay 250 VAC/8A	Stop coil/run (fuel) coil (selectable)
123	Com.		
124	NO	Relay 250 VAC/8A	Start prepare
125	Com.		

1.6.13.2 Optional card with VDO inputs

As an option the VDO card can be installed, please refer to Specifications of options, document no. 4921240240 on www.deif.com.

Term.	Function	Technical data	Description/preconfiguration
98	Analogue input 1 +	+4…20 mA in	4…20 mA input/mains power - peak shaving, configurable
99	Analogue input 1 -	GND	
100	Analogue input 2 +	+4…20 mA in	4…20 mA input/lubricating oil pressure, configurable
101	Analogue input 2 -	GND	
102	Analogue input 3 +	+4…20 mA in	4…20 mA input/fuel oil level, configurable
103	Analogue input 3 -	GND	
104	VDO 1		Configurable (oil pressure)
105	VDO 2		Configurable (water temperature)
106	VDO 3		Configurable (fuel tank level)
107	Common		Common for terminals 104-106
108	Tacho input	0.5…70 VAC	RPM/magnetic pickup/overspeed
109	Tacho input	10…10.000 Hz	
110	Binary input 2	Optocoupler	Configurable
111	Binary input 3	Optocoupler	Configurable
112	Binary input 4	Optocoupler	Configurable
113	Binary input 5	Optocoupler	Configurable
114	Binary input 6	Optocoupler	Access lock, not configurable
115	Binary input 7	Optocoupler	Running feedback, not configurable
116	Binary input 8	Optocoupler	External engine failure, text configurable
117	Binary input 9	Optocoupler	External emergency stop activated, text configurable
118	Binary input 10	Optocoupler	Configurable
119	Com.	Common	Common for terminals 114-118
120	NO	Relay	Start/crank
121	Com.	250 VAC/8A	
122	NO	Relay 9	Stop coil/run (fuel) coil (selectable)
123	Com.	250 VAC/8A	
124	NO	Relay	Start prepare
125	Com.	250 VAC/8A	

1.6.13.3 Access lock (binary input 6)

The access lock is used to disable some of the buttons on the control panel. If the input is set (binary input 6 terminal 114), the functionality of the control panel will be reduced as described below. Also if the control panel is not used for more than 3 minutes, the menu will change to the top level menu (SETUP, V3, V2, V1). From that menu it is not possible to enter the setup menu again.

Button name	Access lock active
INFO	The button is active. It is possible to read all alarms, but it is not possible to acknowledge any of them
JUMP	The button is inactive
START	The button is inactive
STOP	The button is inactive
GB ON	The button is inactive
MB ON	The button is inactive
VIEW	The button is active
LOG	The button is active
LEFT	The button is active
UP	The button is active
SELECT	The button is inactive except if the access lock is set during change in a submenu. It is possible to navigate with no limitations in PROT, CTRL, POWER or SYST, but when the changes have been made and BACK has been pushed, it is not possible to return to the submenu
DOWN	The button is active
BACK	The button is active
RIGHT	The button is active
MODE	The button is active with no limitations if the setup menu (PROT, CTRL, POWER, SYST) is selected. If the menu (SETUP, V3, V2, V1) is selected, the button is inactive

1.6.14 Slot #8, power management (option G4)

Term.	Function	Description
126	Not used	Internal communication
127	Not used	
128	Can-L	
129	GND	
130	Can-H	
131	Can-L	
132	GND	
133	Can-H	

The communication between AGC units is used for the option G4.

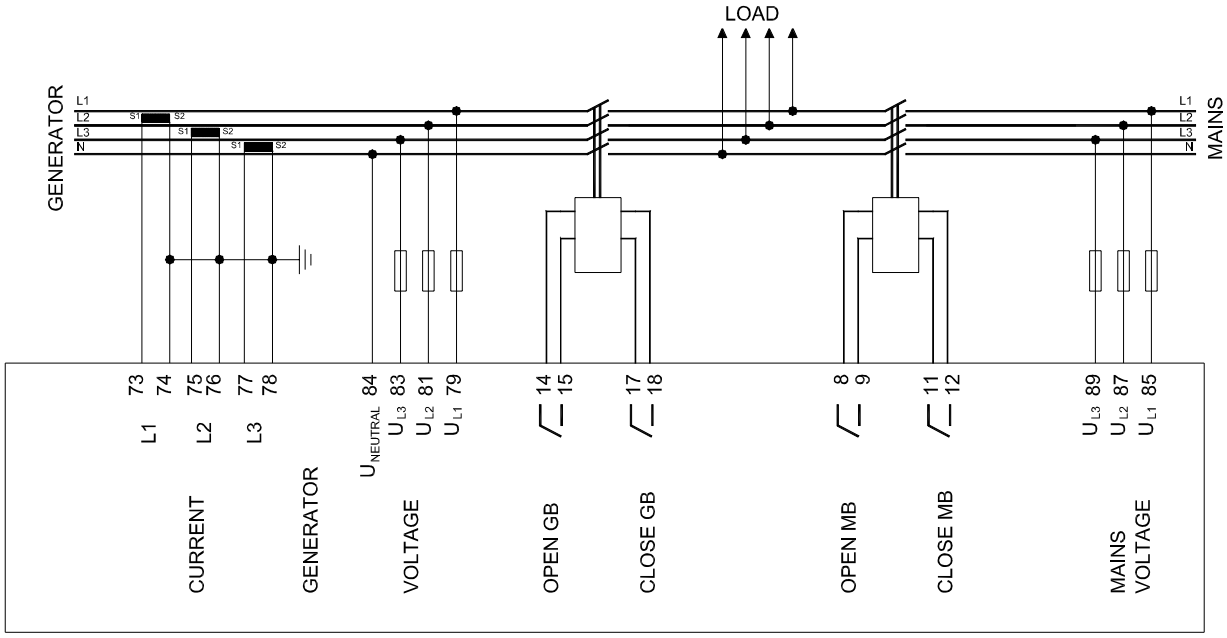
1.6.15 Slot #8, Caterpillar® CCM communication

Term.	Function	Description
126	Not used	
127	Not used	
128	RxD	RS232 receive data from other unit
129	Not used	
130	TxD	RS232 transmit data from multi-line
131	Not used	
132	GND	Ground
133	Not used	

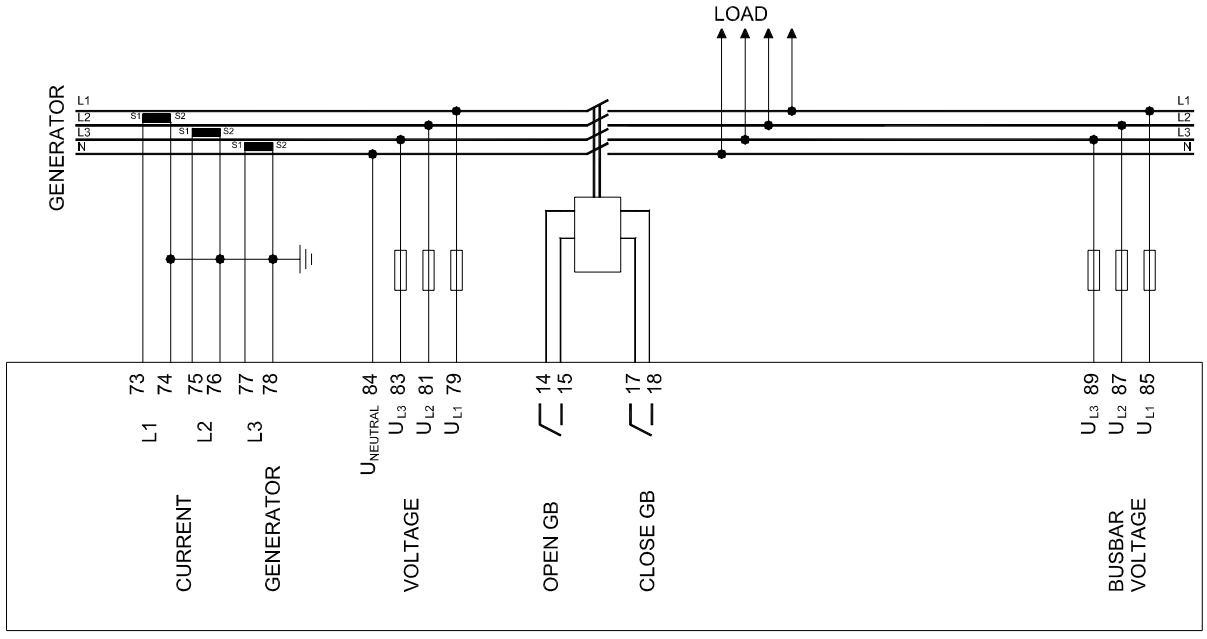
1.7 Wirings

1.7.1 AC connections

1.7.1.1 AMF, peak shaving and fixed power application

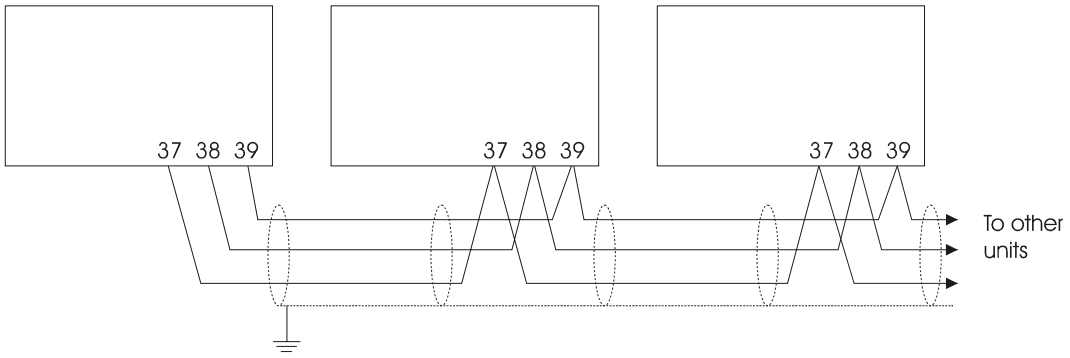


1.7.1.2 Island mode application



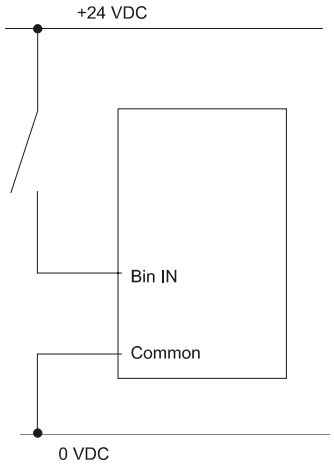
1.7.2 Load sharing lines

Even though screened cable is not needed, it is recommended if the cable run is longer than 5 m between units.



1.7.3 Binary inputs

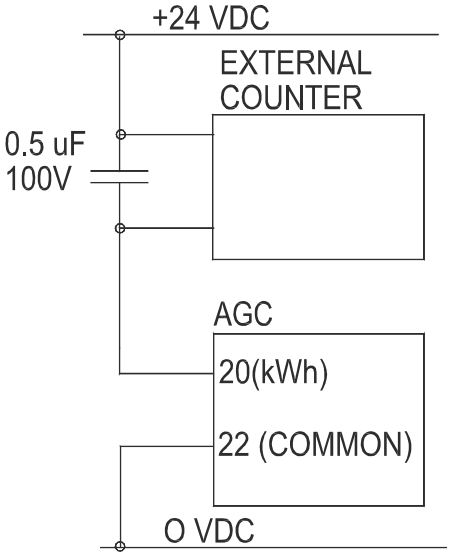
All binary inputs are 24 VDC bi-directional optocoupler. Typical input is:



The binary inputs use fixed signals. They do not use pulse signals.

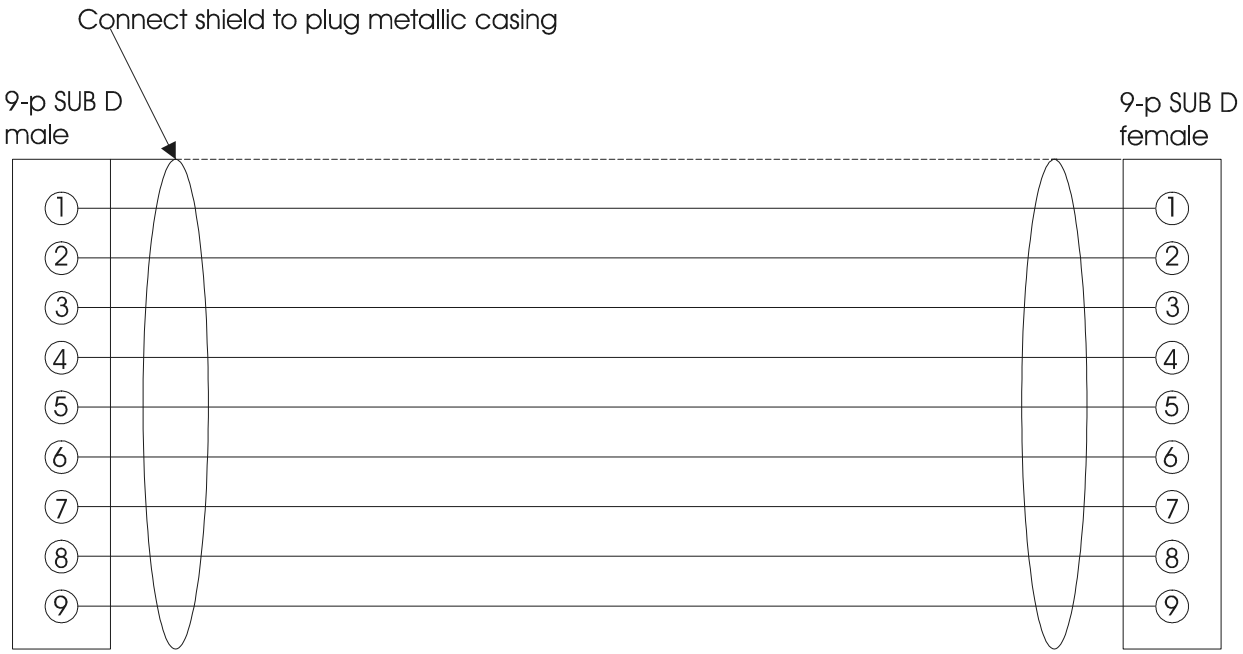
1.7.4 Optocoupler outputs for external counter

The kWh counter (terminals 20-22) and kvarh counter (terminals 21-22) outputs are low-power outputs. For that reason the following circuit must be applied:



1.7.5 Display cable (option J)

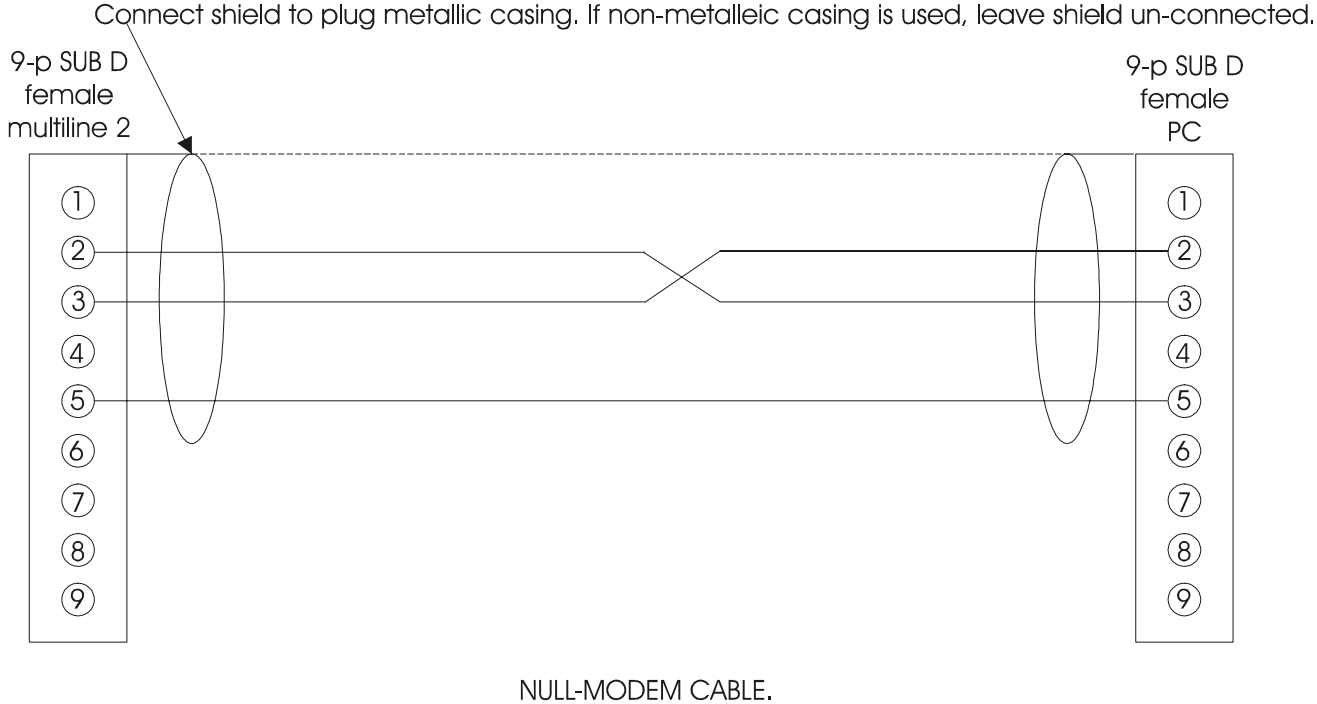
A standard computer extension cable can be used (9-pole SUB-D male/female plugs) or a cable can be tailored:



Wires min. 0.22 mm^2, max. cable length 6 m.
Cable types: Belden 9540, BICC H8146, Brand Rex BE57540 or equivalent.

1.7.6 Serial cable for PC with utility software (option J3)

A standard computer null-modem cable can be used (9-pole SUB-D female/female plugs) or a cable can be tailored:



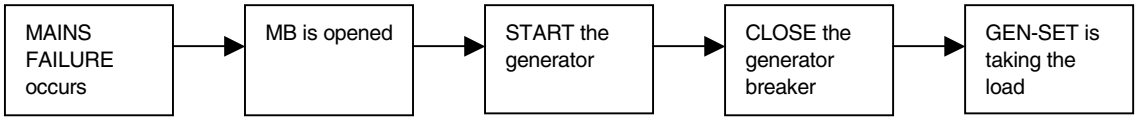
NULL-MODEM CABLE.

1.8 Application examples

1.8.1 Application for Automatic Mains Failure operation

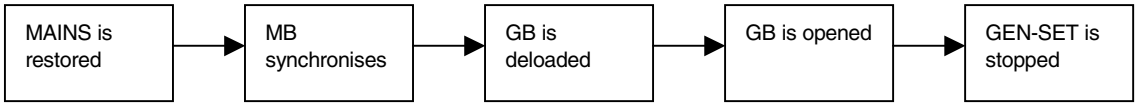
1.8.1.1 Single gen-set

When the multi-line 2 AGC is operating in automatic mains failure operation, the following sequence will be run through in a mains failure situation:



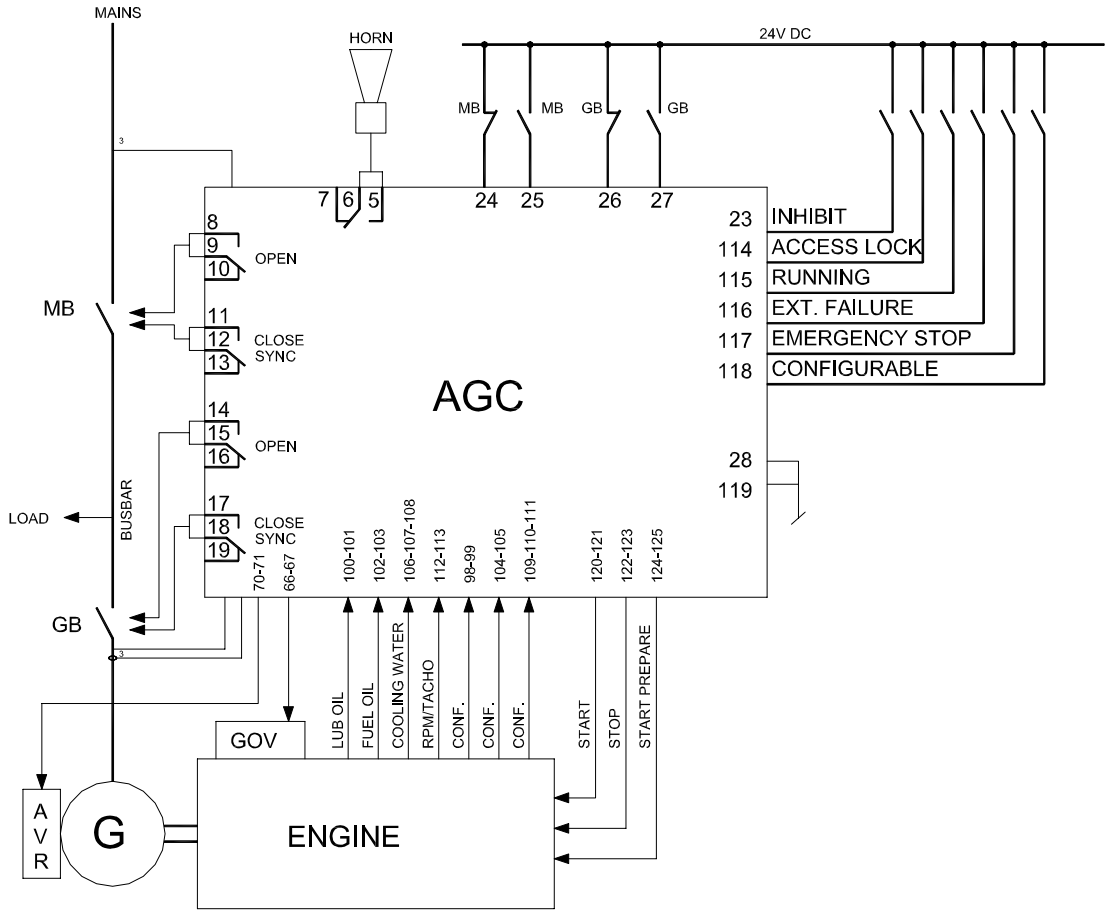
The mains failure must be present in the period “FAIL DELAY” before the MB is opened. The timer “FAIL DELAY” will be reset each time till mains is restored.

When the mains is restored the following sequence is run through:



The mains must have been present in the period “MAINS OK DELAY” before the MB synchronises.

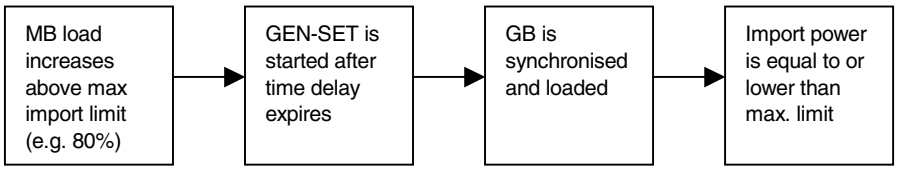
When the gen-set is running it will control the frequency and voltage to the nominal set point.



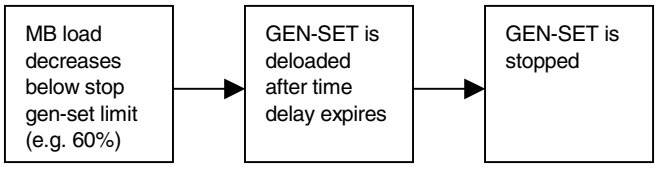
1.8.2 Applications for peak shaving operation

1.8.2.1 Single gen-set

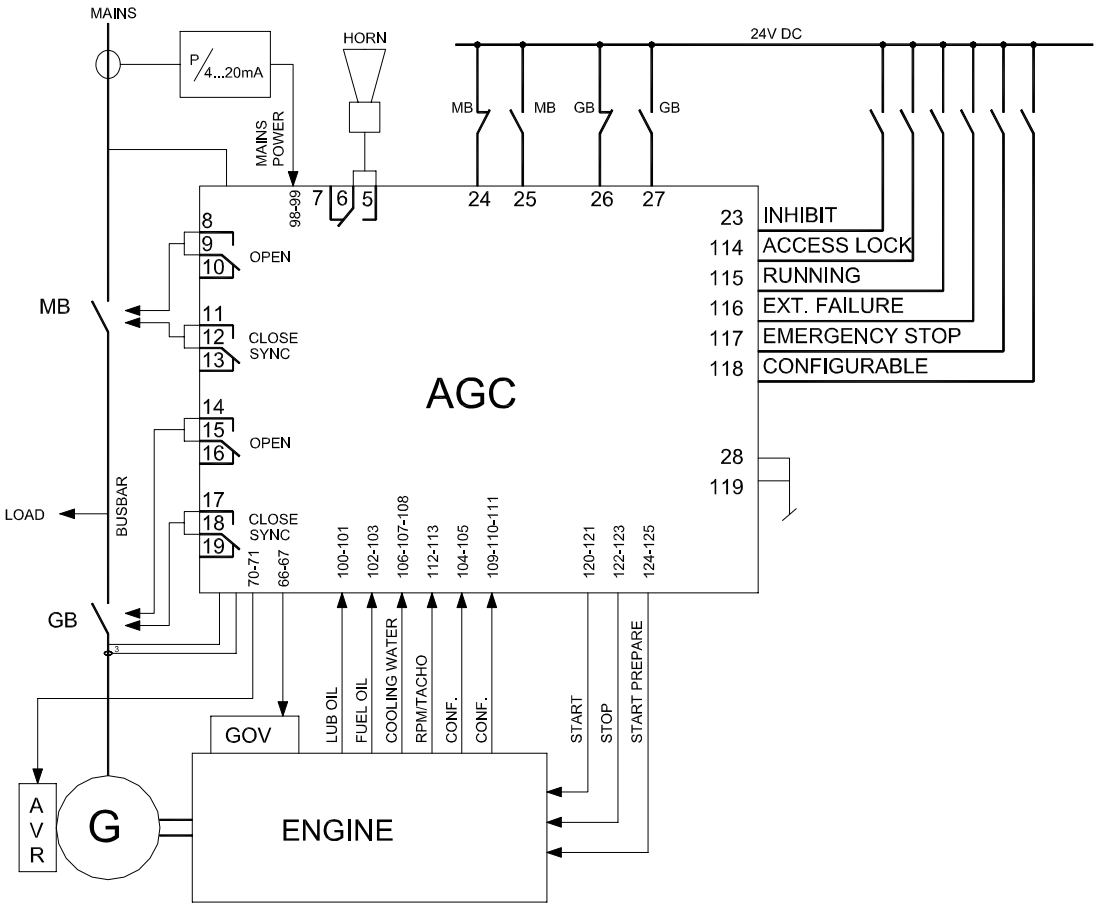
When the multi-line 2 AGC is operating in peak shaving mode, the following sequence will be run through when the generator is stopped and the imported load increases above the configured limit:



When the load decreases below the stop gen-set limit, the following sequence is run through:



When the gen-set is running it will be loaded between the minimum load limit (e.g. 5%) and the maximum nominal generator load.



1.9 Applications for the AGC

This chapter shows the correct application configuration for the different use of the multi-line 2 AGC. The following application configurations are possible:

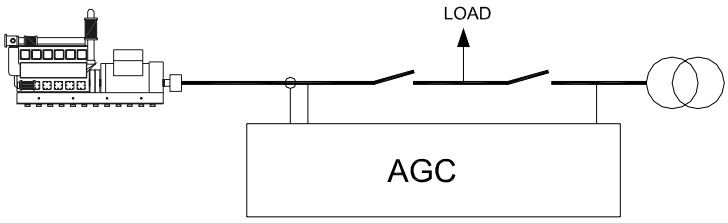
- Single running gen-sets
  - Automatic mains failure operation
  - Island mode
  - Peak shaving
- Multi running gen-sets
  - Island mode
  - Automatic mains failure operation

It is only possible to use the multi-line 2 AGC for one of the purposes, e.g. automatic mains failure operation. The selection must be made on site. All multi-line 2 AGCs are supplied with the factory setting:

- Single gen-set
- Automatic mains failure operation

1.9.1 Single running gen-sets

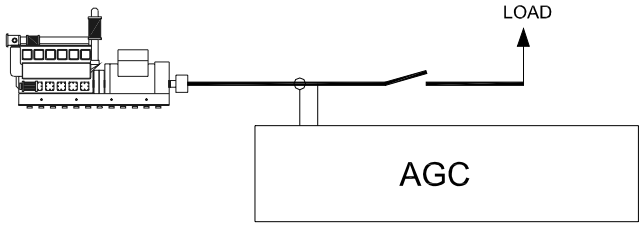
1.9.1.1 Automatic mains failure, AMF operation (factory setting)



No.	Setting		Setting
4310	Running mode	Selection display	-
4311	Running mode	Running mode	Single gen-set

No.	Setting		Setting
4320	Gen-set mode	Selection display	-
4321	Gen-set mode	AMF	AMF

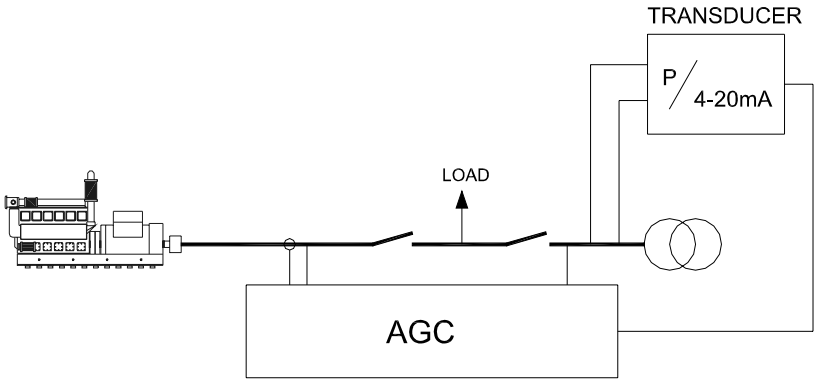
1.9.1.2 Island mode



No.	Setting		Setting
4310	Running mode	Selection display	-
4311	Running mode	Running mode	Single gen-set

No.	Setting		Setting
4320	Gen-set mode	Selection display	-
4321	Gen-set mode	Island operation	Island operation

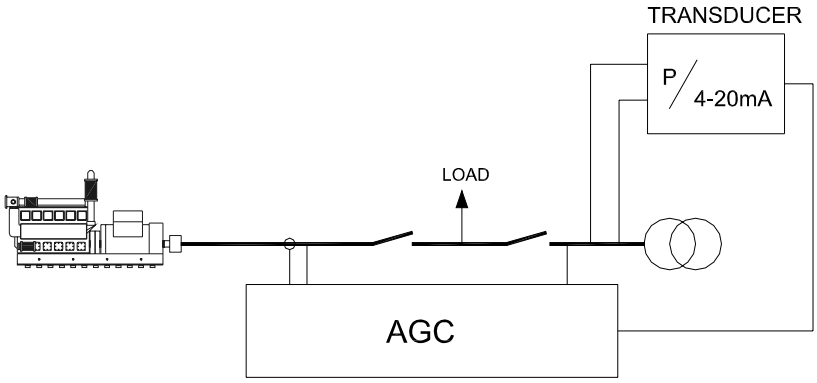
1.9.1.3 Peak shaving



No.	Setting		Setting
4310	Running mode	Selection display	-
4311	Running mode	Running mode	Single gen-set

No.	Setting		Setting
4320	Gen-set mode	Selection display	-
4321	Gen-set mode	Peak shaving	Peak shaving

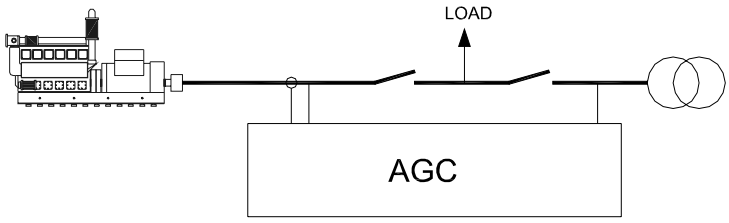
1.9.1.4 Mains power export



No.	Setting		Setting
4310	Running mode	Selection display	-
4311	Running mode	Running mode	Single gen-set

No.	Setting		Setting
4320	Gen-set mode	Selection display	-
4321	Gen-set mode	Mains power export	Mains power export

1.9.1.5 Fixed power operation

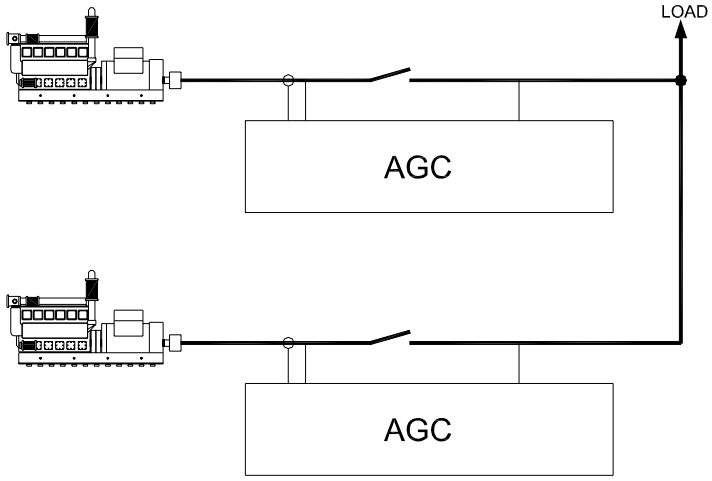


No.	Setting		Setting
4310	Running mode	Selection display	-
4311	Running mode	Running mode	Single gen-set

No.	Setting		Setting
4320	Gen-set mode	Selection display	-
4321	Gen-set mode	Fixed power	Fixed power

1.9.2 Multi running gen-sets

1.9.2.1 Island mode

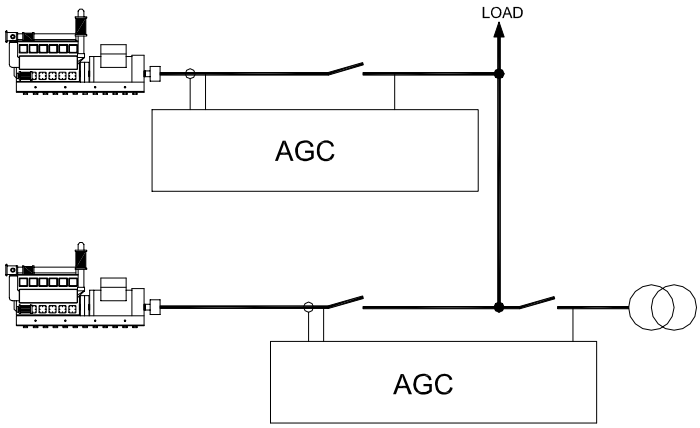


No.	Setting		Setting
4310	Running mode	Selection display	-
4311	Running mode	Running mode	Multi gen-set

No.	Setting		Setting
4320	Gen-set mode	Selection display	-
4321	Gen-set mode	Island operation	Island operation

1.9.2.2 Automatic mains failure operation

Functionality:
A solution with multiple running gen-sets in combination with automatic mains failure operation will be possible using the AGC. This solution will be possible with two gen-sets using option G4 or more than two gen-sets using option G5. Refer to the power management section for detailed information.



No.	Setting		Setting	AGC 1	AGC 2
4310	Running mode	Selection display	-	-	-
4311	Running mode	Running mode	-	Single gen-set	Single gen-set

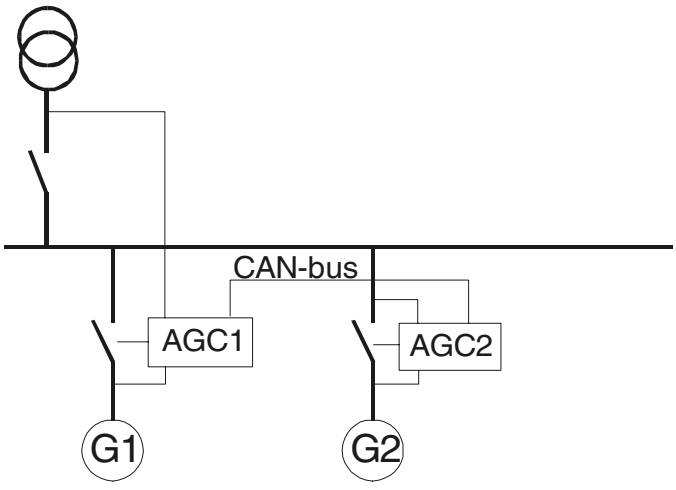
No.	Setting		Setting	AGC 1	AGC 2
4320	Gen-set mode	Selection display	-	-	-
4321	Gen-set mode	AMF	-	AMF	Island

No.	Setting		Setting	AGC 1	AGC 2
4070	Int. communic. ID	Selection display	-	-	-
4071	Int. communic. ID	ID	-	1	2

1.10 Power management

This chapter describes the power management system of the multi-line 2 AGC. The power management can be selected as an optional function and this will give a larger flexibility of the AGC. Two versions of the power management are selectable, option G4 and option G5. Refer to the datasheet “Specification of options” (document no. 4921240240) for information about availability.

1.10.1 Schematic view of the PMS option G4



The AGC 1 is measuring the mains voltage and the generator 1 voltage.
The AGC 2 is measuring the busbar voltage and the generator 2 voltage.

The communication is canbus. The connections are shown in the I/O list 1.6.14.

1.10.2 Introduction of the PMS option G4

It is possible to use 2 gen-sets with the PMS option G4. If more generators are installed the PMS option G5 is required for power management purposes. The power management option G4 is used for both AMF and peak shaving. To activate the master/slave function change both AGCs to “AUTO” operation.

1.10.3 Mode selection

The running modes are selected on the display of each unit.

Mode selection		
Function	**AGC 1**	**AGC 2**
AMF	Auto	Auto
AMF	Auto	Semi-auto
No AMF	Semi-auto	Auto
No AMF	Semi-auto	Semi-auto

1.10.4 Function

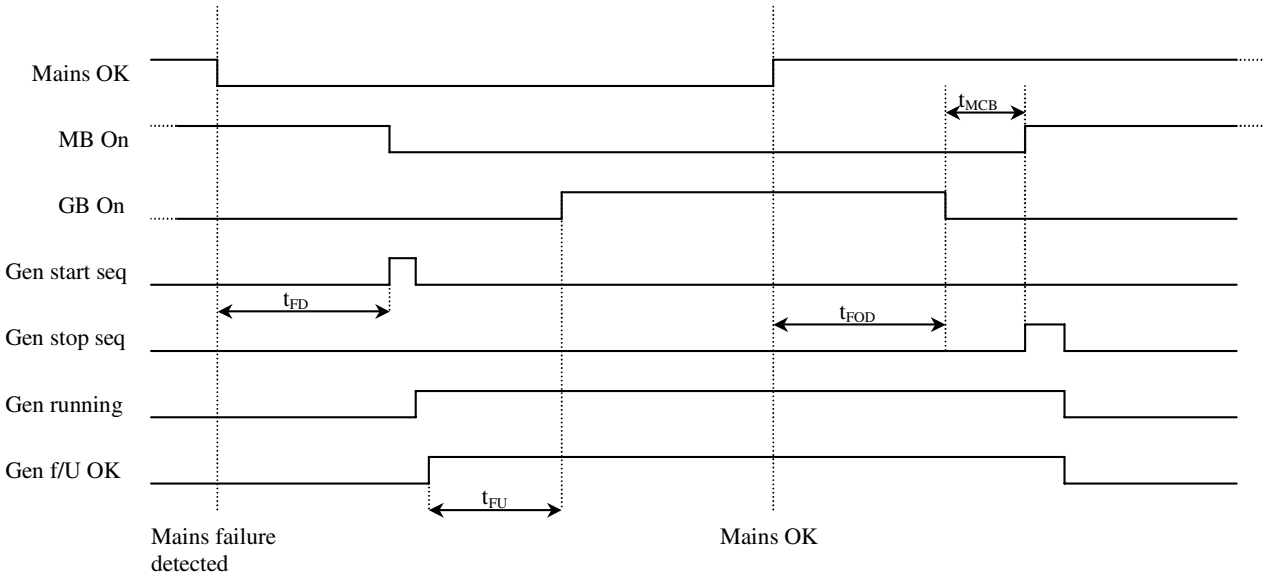
The time charts describe the functionality at a mains failure and at a mains return. Back synchronisation is deactivated.

The timers in the system:

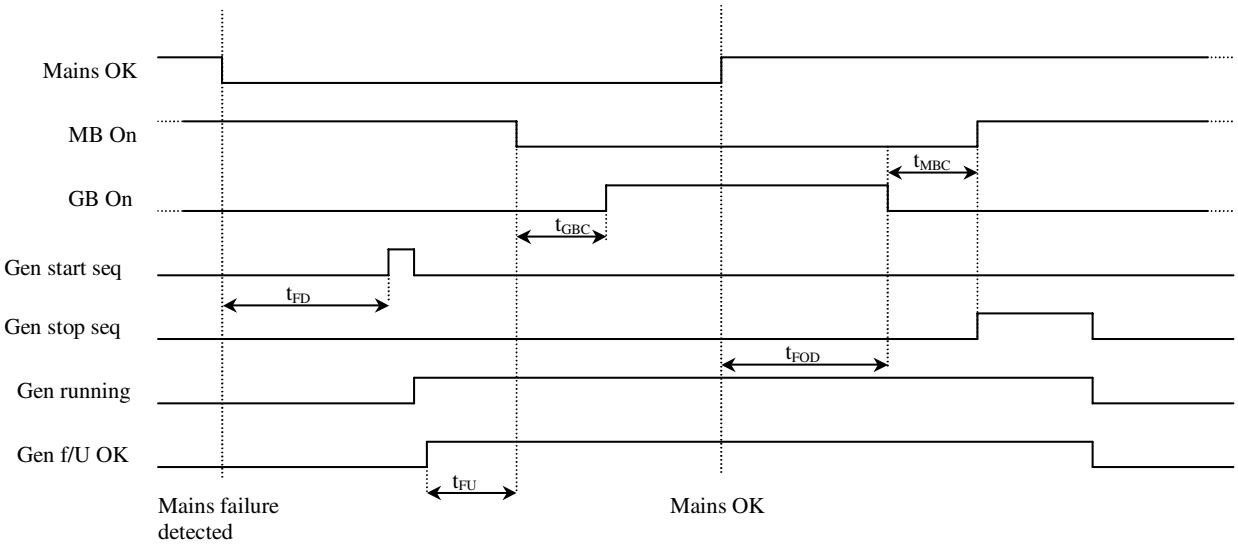
Timer	**Description**	**Channel number**
t_{FD}	Mains failure delay	4421
t_{FU}	Frequency/voltage OK	4381
t_{FOD}	Mains failure OK delay	4422
t_{GBC}	GB ON delay	4451
t_{MBC}	MB ON delay	4432

The timer t_{MBC} is only active if back synchronisation is deactivated (channel 4433). If back synchronisation is active the MB will be synchronised, and the GB is deloaded and opened and the gen-set is cooled down and stopped.

Example 1 (configuration channel 4425: Start engine and open MB):



Example 2 (configuration channel 4425: Start engine):



When a mains failure occurs, all gen-sets are started. If the AGC 1 in "AUTO" operation fails during the mains failure sequence, the AGC 2 closes on the black busbar. This is controlled from the AGC 1. Resetting a start failure alarm on the AGC 1 will cause the gen-set 1 to start without subsequent automatic synchronisation.

1.10.5 Load sharing/var sharing

The canbus communication is used for load/var sharing. If the canbus lines break a communication failure is displayed, and the generators will share the load/var's depending on the droop setting on the speed governors/AVRs.

1.10.6 Test sequence

The test sequence is activated on the master display. The master gen-set will always start no matter which mode is active on the master GEN 1. The slave unit is only started if AUTO mode is selected.

NOTE:
At a mains failure situation when testing gen-set 2, the gen-set 1 will start without subsequent automatic synchronisation to the busbar.

1.11 Configurable inputs/outputs

It is possible to configure all binary inputs (inputs 8-30), analogue inputs (inputs 1-8) and binary outputs (relays 1-10).

Binary inputs:

- The texts can be edited to a user defined name.
- Default all inputs are alarm inputs.
- All inputs can be configured as described below:

Input	Description
Fire pump	All alarms and fail classes are overruled. The only alarms the gen-set will react on are "Emergency stop" on terminal 117 or a "Tacho failure". Also the gen-set has 7 start attempts before "Start failure"
Remote start	The gen-set can be started externally if semi-auto mode is selected
Remote stop	The gen-set can be stopped externally if semi-auto mode is selected
Semi-auto mode	The mode can be changed externally
Test mode	The mode can be changed externally
Auto mode	The mode can be changed externally
Remote GB On	The GB can be set On externally if semi-auto mode is selected
Remote GB Off	The GB can be set Off externally if semi-auto mode is selected
Remote MB On	The MB can be set On externally if semi-auto mode is selected
Remote MB Off	The MB can be set Off externally if semi-auto mode is selected
Remote alarm ack.	All alarms are reset if the input is set
Gen-set start sequence	Automatic starting of the gen-set and subsequent operation in the selected gen-set mode (load take over, fixed power, mains power export) can only be used in auto mode

Analogue inputs:
- The texts can be edited to a user defined name. This name will only be used for the alarm menus.
- The unit, min. and max. values can be edited.

Binary outputs:
- The outputs can be configured as “Alarm” relay.
- The outputs can be configured as “Limit” relay.

NOTE:
The configuration of the binary inputs is done in the utility software. Connect the AGC to the computer and select inputs in the settings menu.

The standard AGC has three configurable binary inputs, four 4…20 mA inputs and two configurable relay outputs.

1.12 Remote control via www

It is possible to communicate with the multi-line 2 through the world wide web or local intranet.

To be able to use this feature, one multi-line 2 must be installed with the TCP/IP hardware, and all multi-line 2 must be installed with modbus communication. The communication with the world wide web is done through the TCP/IP unit. This unit communicates through modbus with the other units in the system.

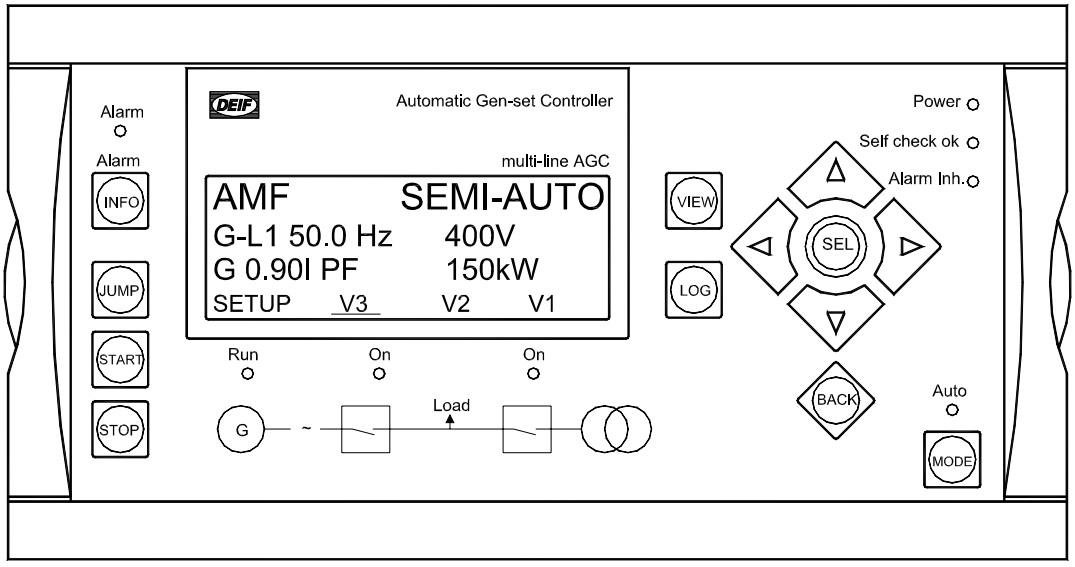
The web pages show the installation with the gen-sets, the breakers and the multi-line 2 units. Clicking on the icons on the screen gives access to the following:

Status:	Screen showing the alarms and the status of all control inputs.
Messages:	Creates and sends e-mail messages if alarms occur.
Settings:	Screen showing setup menus.
Measurements:	The relevant values can be chosen between all measured gen-set values.

1.13 Display unit

The display unit used in multi-line 2 communicates and receives power supply via a 9-pole Sub-D plug. The plug fits directly onto the main unit, so the display can be mounted on the top of the main unit.

If the display is to be used as remote display, a standard computer extension cable with male/female plug can be used for the connection (option J).



Display dimensions H x W x D = 115 x 220 x 20 mm.

1.13.1 Pushbutton functions

There are 15 pushbuttons on the display unit with the following functions:

INFO: Shifts the display 3 lower lines to show the alarm list (up to 30 alarms can be in the list).

JUMP: Enters a menu number selection. All settings have a specific number attached to them. Using the JUMP button enables the user to select and display any setting without navigating all the way through the menus (see later).

VIEW: Shifts the upper line displaying.

LOG: Shifts the display 3 lower lines to show the event and alarm list. The list holds 100 events. These events are erased when the main unit is switched off.

 : Moves the cursor left for manoeuvring in the menus.

 : Increases the value of the selected set-point (in the setting menus). In the daily use display it is used for scrolling the second line displaying of generator values.

SEL: Is used to select the chosen function (underscored selection in the lower line of the display).

 : Decreases the value of the selected set-point (in the setting menus). In the daily use display it is used for scrolling the second line displaying of generator values

 : Moves the cursor right for manoeuvring in the menus.

BACK: Jumps one step backwards in the menu (to previous display or to the entry window).

START: Start of the gen-set if “SEMI-AUTO” is selected. *****

STOP: Stop of the gen-set if “SEMI-AUTO” is selected. *****

(GB) ON: Manual activation of close breaker and open breaker sequence if “SEMI-AUTO” is selected. *****

(MB) ON: Manual activation of close breaker and open breaker sequence if “SEMI-AUTO” is selected. *****

MODE: Changes the menu line (line 4) in the display to mode selection.

***** In island mode it is only possible to operate the AGC in “SEMI-AUTO” operation.

1.13.2 LED functions

10 LEDs are used on the display unit. The colour is green or red or a combination in different situations.

Alarm: LED flashing indicates that unacknowledged alarms are present.
LED fixed light indicates that ALL alarms are acknowledged.

Power: LED indicates that the auxiliary supply is switched on.

Self check ok: LED indicates that the unit is OK.

Alarm inh.: LED fixed light indicates that the inhibit input is ON.

Run: LED indicates that the generator is running.

(GEN.) OK: LED green light indicates that the voltage/frequency is present and OK.

(GB) ON: LED indicates that the generator breaker is closed.

(MB) ON: LED indicates that the mains breaker is closed.

(MAINS) OK: LED is green if the mains are present and OK.
LED is red at a mains failure.
LED is flashing green when the mains return during the “Mains OK delay” time.

Auto: LED indicates that auto mode is selected.

The main unit includes 3 LEDs:

Power: LED indicates that the auxiliary supply is switched on.

Self check ok: LED indicates that the unit is OK.

Alarm inhibit: LED fixed light indicates that the inhibit input is ON.

1.13.3 Display functions

There are different uses of the display depending on which display window is used. The VIEW windows or the SETUP menu windows can be used.

1.13.3.1 Setup menu

	First line in display
Daily use display	Generator voltage L1 L2 L3 (VAC) Bus/mains voltage L1 L2 L3 (VAC) Generator current L1 L2 L3 (A) Generator power factor and active power (kW) Generator apparent power (kVA) and reactive power (kvar) Generator L1 frequency (Hz) and voltage (VAC) Bus/mains L1 frequency (Hz) and voltage (VAC)

	Second line in display
Daily use display	The second line is a service line where various values can be shown. The values are listed in the table below. Scrolling is done using the ▲ and ▼ keys. The values available are shown in the table on the next page.
Menu system	When entering the menu system, the second line in the display is used for information about which function (with function identifying number) is chosen. Using the ▲ and ▼ keys will scroll through the settings.
Alarm and event list	When selecting the alarm (and event) list, the second line will display the latest alarm/event. Using the ▲ and ▼ keys will scroll through the list.

Parameters shown in the second line in the display:

Second line in display		
For generator:	**For bus/mains:**	**For analogue input:**
Date and time	Voltage L1-N (VAC)	Analog 1
Voltage L1-N (VAC)	Voltage L2-N (VAC)	Analog 2
Voltage L2-N (VAC)	Voltage L3-N (VAC)	Analog 3
Voltage L3-N (VAC)	Voltage L1-L2 (VAC)	Analog 4
Voltage L1-L2 (VAC)	Voltage L2-L3 (VAC)	Analog 5
Voltage L2-L3 (VAC)	Voltage L3-L1 (VAC)	Analog 6
Voltage L3-L1 (VAC)	Voltage max. (VAC)	Analog 7
Voltage max. (VAC)	Voltage min. (VAC)	Analog 8
Voltage min. (VAC)	Frequency (Hz)	PT100 no. 1
Current L1 (A)	Voltage angle between L1-L2 (deg.)	PT100 no. 2
Current L2 (A)	Voltage angle between generator	Tacho
Current L3 (A)	voltage and bus voltage (deg.)	
Frequency L1 (Hz)	Power supply voltage (VDC)	
Frequency L2 (Hz)		
Frequency L3 (Hz)		
Active power (kW)		
Reactive power (kvar)		
Apparent power (kVA)		
Energy counter (kWh)		
Power factor		
Voltage angle between L1-L2 (deg.)		
Voltage angle between L2-L3 (deg.)		
Voltage angle between L3-L1 (deg.)		
Run time (h)		
Number of GB operations		
Number of MB operations		
Next service		

	Third line in display
Daily use display	The third line is an indication line. The third line contains an explanation for the fourth line selection of setup.
Parameter menu display	In the parameter menu the third line indicates the present setting of the function in question, and, if changes are to be made, the max. and min. possible value for the setting.

	Fourth line in display
Parameter menu display	When entering the parameter menus, the first (entry) display uses the fourth line to select a sub-function for the parameter. What the selections are depends on the function selected.
Daily use display	In the daily use display, the fourth line is the entry selection for the parameter menu. If “SEL” is pressed, the selection of menu indicated with an underscore will be entered. Choises are: “PROT”, protection setup “CTRL”, controls setup “POWER”, power control setup “SYST”, system setup

Examples of the displayed text:

Protection setup:
For protective function the first entry shows the “gen high volt 1” setting (provided the option is chosen). In this case the fourth line shows:

“LIM”, setting of set-point
“DEL”, setting of time delay
“OA” and “OB”, selection of which relay the function must activate
“ACT”, activate/de-activate the function
“FC”, fail class setting

Control setup:
For control functions one entry shows the “Synchronisation” function. In this case the fourth line shows:

“fMax”, max. allowed positive frequency deviation when synchronising
“fMin”, min. allowed negative frequency deviation when synchronising
“Umax”, max. allowed voltage deviation (positive or negative) when synchronising
“tCB”, closing time delay for generator circuit breaker

Power setup:
For power setup the first entry shows the “Mains power” setting. In this case the fourth line shows:

“DAY”, setting of the maximum allowed imported power during the daytime period
“NIGHT”, setting of the maximum allowed imported power during the nighttime period
“TRANS”, setting of the transducer scale for the transducer used in the peak shaving system

System setup:
For system setup the first entry shows the “Nominal settings”. In this case the fourth line shows:

“f”, nominal frequency setting
“P”, nominal generator power setting
“I”, nominal generator current setting
“U”, nominal generator voltage setting

The above settings are used by the AGC to calculate the nominal apparent power and the power factor.

1.13.3.2 View menu

The menu navigating starts from the fourth line in the start window and is carried out using the “SEL”,  and “BACK” pushbuttons. It is also possible to use the “JUMP” pushbutton and then enter the specific channel number (e.g. 1411) or channel group number (e.g. 1410).

The start window shows the software version in the first line. The second line shows date and time. In line four it is possible to select one of four menus:

- **Setup menu** – access the following sub menus:
  - Protection setup
  - Control setup
  - Power setup
  - System setup
- **View 1** – gives access to up to 15 selectable windows showing selectable measurements
- **View 2** – window shows selectable measurements
- **View 3** – window shows operational status and selectable measurements

Enter the setup menu by moving the cursor to “SETUP” and press “SEL”. Enter the view windows by moving the cursor to “V1”, “V2” or “V3”. “V1” shows up to 15 selectable windows. These windows are exchanged with the  and  pushbuttons. “V2” and “V3” show the 5 first windows also shown in “V1”. These windows are exchanged automatically by the operational change.

The view function is the daily use display. It is possible to make the relevant configuration of all measuring values and text lines through the utility software.

Windows	View 1	View 2	View 3
Window 1 (used in V2, V3)	Manual selection with key UP or key DOWN pushbuttons	Changes automatically between the 5 first windows: 1. window 1 (Start prepare) 2. window 2 (Sync.) 3. window 3 (Ramp up/down) 4. window 4 5. window 5 (Default*) No manual selection. All three lines show measuring values	Changes automatically between the 5 first windows: 1. window 1 (Start prepare) 2. window 2 (Sync.) 3. window 3 (Ramp up/down) 4. window 4 5. window 5 (Default*) No manual selection. Line 1 shows the text 1…5. Line 2 and line 3 show measure-ments
Window 2 (used in V2, V3)			
Window 3 (used in V2, V3)			
Window 4 (used in V2, V3)			
Window 5 (used in V2, V3)			
Window 6			
Window 7			
Window 8			
Window 9			
Window 10			
Window 11			
Window 12			
Window 13			
Window 14			
Window 15			

* The default window is automatically selected when the genset is in normal operation, e.g. fixed power mode, but after the ramping up.

When the display shows the entry window or one of the view windows the fourth line always gives access to the setup menu or one of the view windows. When working in the setup menu it is possible to enter the view windows by using the “BACK” pushbutton until the entry window is displayed.

The configuration of the “VIEW” windows is done through the utility software. It is not possible to configure the windows through the display.

During synchronisation view 3 will show a synchronoscope in the first line. The synchronoscope can also be selected in all the configurable windows. This is useful during manual synchronising.

Entering view 1 gives access of up to 15 configurable windows. These windows are selected with the and pushbuttons. The window shown when leaving “V1” will be the window shown when returning to “V1”.

The selectable values and measurements are shown in the table in chapter 1.13.3.1 in this handbook.

If the text “No text” is selected in all three lines in a window it will not be displayed. This is to get a continuous displaying if a window is no longer to be shown.

1.14 Menu overview

The following is the menu structure when entering settings of the AGC. If no entry has taken place before, the first display to appear is the password display. Enter the factory setting password to gain access to the menus.

If no actions have been taken within 3 minutes, the password entry will be de-activated, and a new password entry will be needed.

The menu overview is divided according to the daily use display selections in the fourth line (“PROT”, “CTRL”, “POWER”, “SYST”).

1.14.1 Jump functions

The “JUMP” pushbutton is used to enter an exact channel number, and all channels can be entered using this button.

The following menus can only be reached using the “JUMP” pushbutton:

Use the and buttons to change the settings and the “SEL” button to store the new setting.

Password setting: Channel 4976
Service menu: Channel 4980

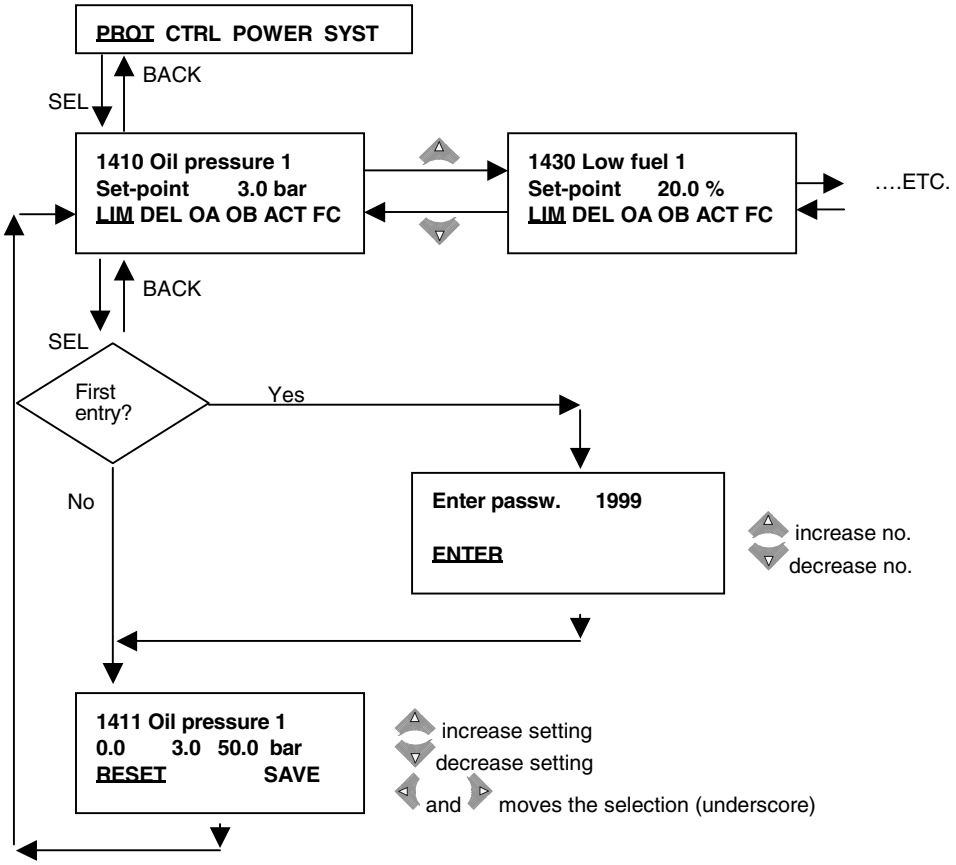
BEWARE:
Write down the new password. If you forget it, contact DEIF Support for details.

1.14.2 Navigating in the menus

1.14.2.1 Setup menu system

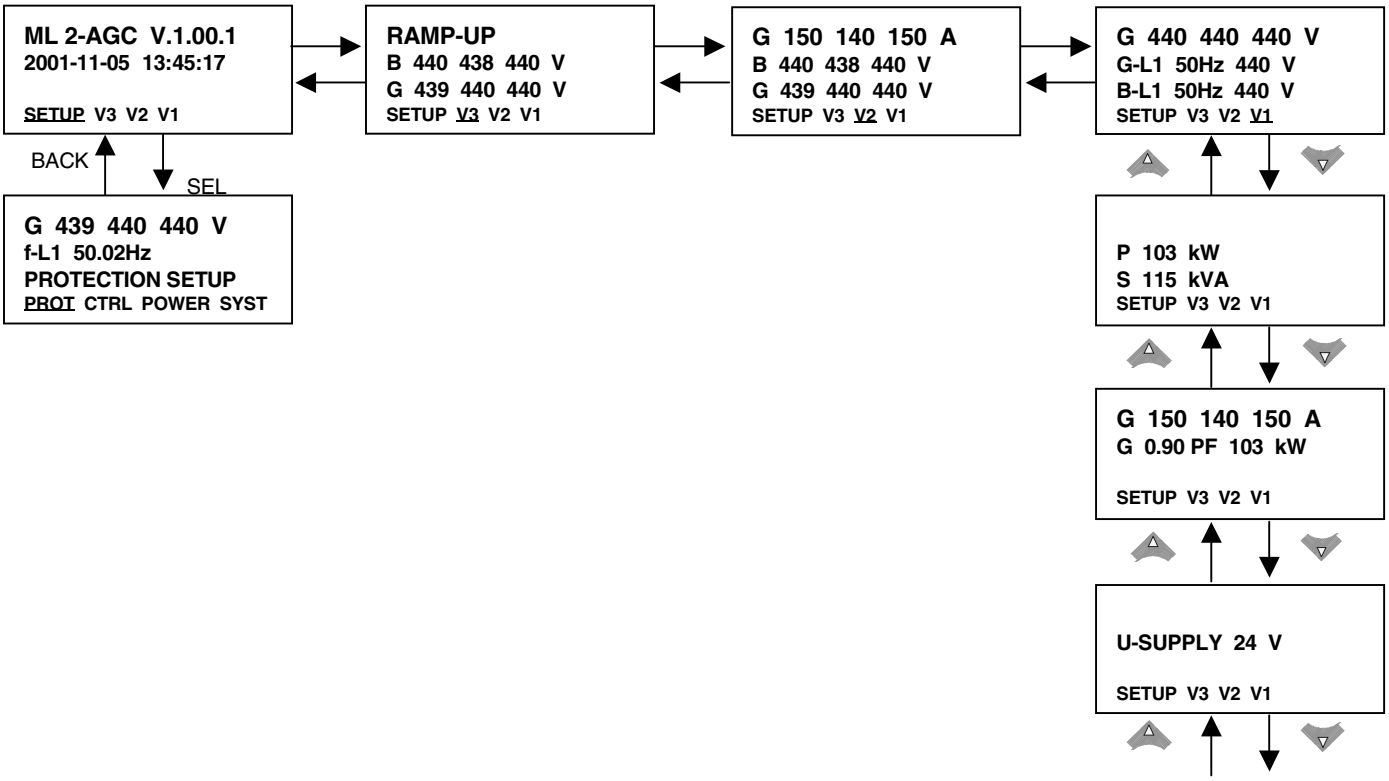
The following is an example, but all menus operate in the same manner.

Starting from the daily use display fourth line, select the menu indicated with underscore: (Move the underscore with the and pushbuttons).



1.14.2.2 View menu system

The following is an example of a configuration. In this example 4 of 15 windows have been configured in view 1.



....ETC. (MAX. 15)

1.15 Mode selection

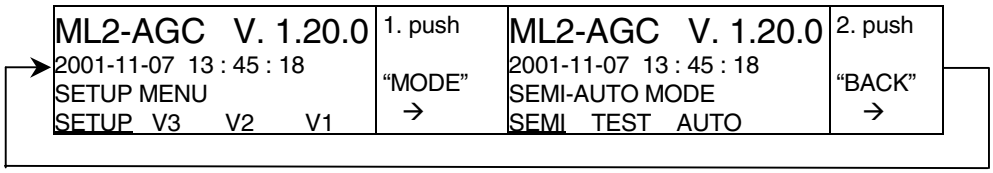
The multi-line 2 AGC is able to run in three different modes which can be selected on the display. The selectable modes are:

- Semi-auto
- Test
- Auto

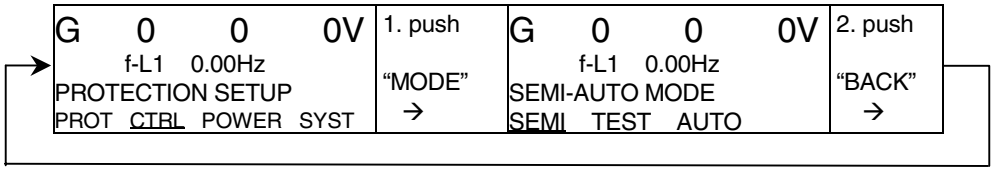
The drawings below explain the selection principle.

Pushing the “MODE” pushbutton will change the original text displayed in line 3 and line 4. After pushing “MODE”, the display will (in line 4) show the three modes which can be selected. In line 3 the underscored (fourth line) selection will be displayed. Now two possibilities are available.

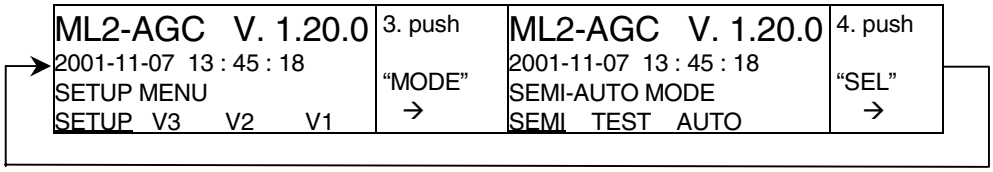
If “BACK” is pushed, the display returns to the original text without changing the mode.



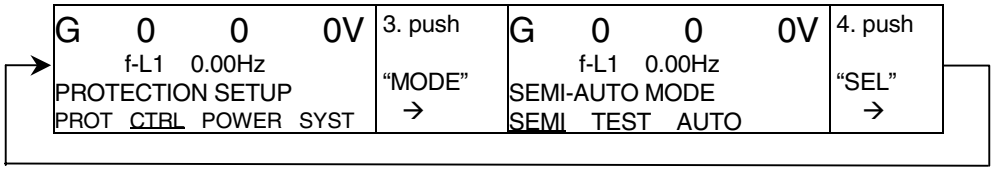
or



If “SEL” is pushed the underlined mode is selected and the display returns to the original text. In this example the SEMI-AUTO mode is selected.



or



1.16 Fail classes

All the activated alarms of the multi-line 2 AGC must be configured with a fail class. The fail classes define the category of the alarms and the subsequent action of the alarm.

5 different fail classes can be used:

Fail class	Action							
	Alarm horn relay	Alarm display	Block engine start	Deload	Trip of mains breaker	Trip of gen. breaker	Stop generator	Shutdown
1 Alarm	X	X	X					
2 Warning	X	X						
3 Trip of GB	X	X				X		
4 Trip and stop	X	X		X		X	X	
5 Shut down	X	X				X		X
6 Trip of MB	X	X			X			

The fail classes in the menu set-points are represented with one of the numbers 1…6 from the table above even though the fail class texts are shown in the display. E.g. WARNING.

1.17 Menu set-points

The following lists are in numerical order, i.e. the set-points and timers appear according to the given number. The maximum relay setting is depending on the options selected. The maximum relay settings are described in the table below:

Options	Max. setting
Standard	R0 (none)
M12	R8 (relay 8)
M14	R4 (relay 4)
Not D1 or D2 or E1	R10 (relay 10)

As the relays have been given a unique number, the number of relays available is not always the same as the max. number shown on the display. An example could be if M14 is not selected together with M12, the relays R1 to R4 are still selectable on the display. If it is attempted to download a relay number which is not available, an error will occur on the display, and the relay number will be set to the standard R0.

1.17.1 Protection setup

***** R0 (none): Refer to chapter 1.17 for max. relay setting.

1.17.1.1 Bus voltage protection (option A or B)

Voltage selections relate to nominal phase-to-phase voltage.

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1010	Bus high volt. 1	Selection display	-	-	-	-
1011	Bus high volt. 1	Set-point	100.0%	120.0%	-	103.0%
1012	Bus high volt. 1	Timer	0.10 s	99.99 s	-	10.00 s
1013	Bus high volt. 1	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1014	Bus high volt. 1	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1015	Bus high volt. 1	Enable	OFF	ON	RUN	OFF
1016	Bus high volt. 1	Fail class	1	5	-	2

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1020	Bus high volt. 2	Selection display	-	-	-	-
1021	Bus high volt. 2	Set-point	100.0%	120.0%	-	105.0%
1022	Bus high volt. 2	Timer	0.00 s	99.99 s	-	5.00 s
1023	Bus high volt. 2	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1024	Bus high volt. 2	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1025	Bus high volt. 2	Enable	OFF	ON	RUN	OFF
1026	Bus high volt. 2	Fail class	1	5	-	2

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1030	Bus low volt. 1	Selection display	-	-	-	-
1031	Bus low volt. 1	Set-point	80.0%	100.0%	-	97.0%
1032	Bus low volt. 1	Timer	0.10 s	99.99 s	-	10.00 s
1033	Bus low volt. 1	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1034	Bus low volt. 1	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1035	Bus low volt. 1	Enable	OFF	ON	RUN	OFF
1036	Bus low volt. 1	Fail class	1	5	-	2

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1040	Bus low volt. 2	Selection display	-	-	-	-
1041	Bus low volt. 2	Set-point	50.0%	100.0%	-	95.0%
1042	Bus low volt. 2	Timer	0.00 s	99.99 s	-	5.00 s
1043	Bus low volt. 2	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1044	Bus low volt. 2	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1045	Bus low volt. 2	Enable	OFF	ON	RUN	OFF
1046	Bus low volt. 2	Fail class	1	5	-	2

1.17.1.2 Bus frequency protection (option A or B)

Frequency settings relate to nominal frequency setting.

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1050	Bus high freq. 1	Selection display	-	-	-	-
1051	Bus high freq. 1	Set-point	100.0%	120.0%	-	103.0%
1052	Bus high freq. 1	Timer	0.10 s	99.99 s	-	10.00 s
1053	Bus high freq. 1	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1054	Bus high freq. 1	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1055	Bus high freq. 1	Enable	OFF	ON	RUN	OFF
1056	Bus high freq. 1	Fail class	1	5	-	2

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1060	Bus high freq. 2	Selection display	-	-	-	-
1061	Bus high freq. 2	Set-point	100.0%	120.0%	-	105.0%
1062	Bus high freq. 2	Timer	0.00 s	99.99 s	-	5.00 s
1063	Bus high freq. 2	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1064	Bus high freq. 2	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1065	Bus high freq. 2	Enable	OFF	ON	RUN	OFF
1066	Bus high freq. 2	Fail class	1	5	-	2

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1070	Bus low freq. 1	Selection display	-	-	-	-
1071	Bus low freq. 1	Set-point	80.0%	100.0%	-	97.0%
1072	Bus low freq. 1	Timer	0.10 s	99.99 s	-	10.00 s
1073	Bus low freq. 1	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1074	Bus low freq. 1	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1075	Bus low freq. 1	Enable	OFF	ON	RUN	OFF
1076	Bus low freq. 1	Fail class	1	5	-	2

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1080	Bus low freq. 2	Selection display	-	-	-	-
1081	Bus low freq. 2	Set-point	80.0%	100.0%	-	95.0%
1082	Bus low freq. 2	Timer	0.00 s	99.99 s	-	5.00 s
1083	Bus low freq. 2	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1084	Bus low freq. 2	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1085	Bus low freq. 2	Enable	OFF	ON	RUN	OFF
1086	Bus low freq.2	Fail class	1	5	-	2

1.17.1.3 Generator voltage protection (option C1)

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1310	Gen. high volt. 1	Selection display	-	-	-	-
1311	Gen. high volt. 1	Set-point	100.0%	120.0%	-	103.0%
1312	Gen. high volt. 1	Timer	0.1 s	100.0 s	-	10.0 s
1313	Gen. high volt. 1	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1314	Gen. high volt. 1	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1315	Gen. high volt. 1	Enable	OFF	ON	RUN	OFF
1316	Gen. high volt. 1	Fail class	1	5	-	2

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1320	Gen. high volt. 2	Selection display	-	-	-	-
1321	Gen. high volt. 2	Set-point	100.0%	120.0%	-	105.0%
1322	Gen. high volt. 2	Timer	0.1 s	100.0 s	-	5.0 s
1323	Gen. high volt. 2	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1324	Gen. high volt. 2	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1325	Gen. high volt. 2	Enable	OFF	ON	RUN	OFF
1326	Gen. high volt. 2	Fail class	1	5	-	2

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1330	Gen. low volt. 1	Selection display	-	-	-	-
1331	Gen. low volt. 1	Set-point	80.0%	100.0%	-	97.0%
1332	Gen. low volt. 1	Timer	0.1 s	100.0 s	-	10.0 s
1333	Gen. low volt. 1	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1334	Gen. low volt. 1	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1335	Gen. low volt. 1	Enable	OFF	ON	RUN	OFF
1336	Gen. low volt. 1	Fail class	1	5	-	2

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1340	Gen. low volt. 2	Selection display	-	-	-	-
1341	Gen. low volt. 2	Set-point	50.0%	100.0%	-	95.0%
1342	Gen. low volt. 2	Timer	0.1 s	100.0 s	-	5.0 s
1343	Gen. low volt. 2	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1344	Gen. low volt. 2	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1345	Gen. low volt. 2	Enable	OFF	ON	RUN	OFF
1346	Gen. low volt.2	Fail class	1	5	-	2

1.17.1.4 Generator frequency protection (option C1)

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1350	Gen. high freq. 1	Selection display	-	-	-	-
1351	Gen. high freq. 1	Set-point	100.0%	120.0%	-	103.0%
1352	Gen. high freq. 1	Timer	0.2 s	100.0 s	-	10.0 s
1353	Gen. high freq. 1	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1354	Gen. high freq. 1	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1355	Gen. high freq. 1	Enable	OFF	ON	RUN	OFF
1356	Gen. high freq. 1	Fail class	1	5	-	2

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1360	Gen. high freq. 2	Selection display	-	-	-	-
1361	Gen. high freq. 2	Set-point	100.0%	120.0%	-	105.0%
1362	Gen. high freq. 2	Timer	0.2 s	100.0 s	-	5.0 s
1363	Gen. high freq. 2	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1364	Gen. high freq. 2	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1365	Gen. high freq. 2	Enable	OFF	ON	RUN	OFF
1366	Gen. high freq. 2	Fail class	1	5	-	2

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1370	Gen. low freq. 1	Selection display	-	-	-	-
1371	Gen. low freq. 1	Set-point	80.0%	100.0%	-	97.0%
1372	Gen. low freq. 1	Timer	0.2 s	100.0 s	-	10.0 s
1373	Gen. low freq. 1	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1374	Gen. low freq. 1	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1375	Gen. low freq. 1	Enable	OFF	ON	RUN	OFF
1376	Gen. low freq. 1	Fail class	1	5	-	2

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1380	Gen. low freq. 2	Selection display	-	-	-	-
1381	Gen. low freq. 2	Set-point	80.0%	100.0%	-	95.0%
1382	Gen. low freq. 2	Timer	0.2 s	100.0 s	-	5.0 s
1383	Gen. low freq. 2	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1384	Gen. low freq. 2	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1385	Gen. low freq. 2	Enable	OFF	ON	RUN	OFF
1386	Gen. low freq. 2	Fail class	1	5	-	2

1.17.1.5 Generator reverse power protection (standard function)

Reverse power settings relate to nominal power setting.

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1090	Reverse power	Selection display	-	-	-	-
1091	Reverse power	Set-point	-50.0%	0.0%	-	-5.0%
1092	Reverse power	Timer	0.1 s	100.0 s	-	10.0 s
1093	Reverse power	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1094	Reverse power	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1095	Reverse power	Enable	OFF	ON	RUN	ON
1096	Reverse power	Fail class	1	5	-	3

1.17.1.6 Generator overcurrent protection (standard function)

Settings relate to nominal generator current.

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1100	Over current 1	Selection display	-	-	-	-
1101	Over current 1	Set-point	50.0%	200.0%	-	115.0%
1102	Over current 1	Timer	0.1 s	100.0 s	-	10.0 s
1103	Over current 1	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1104	Over current 1	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1105	Over current 1	Enable	OFF	ON	RUN	ON
1106	Over current 1	Fail class	1	5	-	2

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1110	Over current 2	Selection display	-	-	-	-
1111	Over current 2	Set-point	50.0%	200.0%	-	120.0%
1112	Over current 2	Timer	0.1 s	100.0 s	-	5.0 s
1113	Over current 2	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1114	Over current 2	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1115	Over current 2	Enable	OFF	ON	RUN	ON
1116	Over current 2	Fail class	1	5	-	3

1.17.1.7 Generator overload protection (option C1)

Settings relate to nominal power setting.

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1160	Over load 1	Selection display	-	-	-	-
1161	Over load 1	Set-point	1.0%	200.0%	-	100.0%
1162	Over load 1	Timer	0.1 s	100.0 s	-	10.0 s
1163	Over load 1	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1164	Over load 1	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1165	Over load 1	Enable	OFF	ON	RUN	OFF
1166	Over load 1	Fail class	1	5	-	2

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1170	Over load 2	Selection display	-	-	-	-
1171	Over load 2	Set-point	1.0%	200.0%	-	110.0%
1172	Over load 2	Timer	0.1 s	100.0 s	-	5.0 s
1173	Over load 2	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1174	Over load 2	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1175	Over load 2	Enable	OFF	ON	RUN	OFF
1176	Over load 2	Fail class	1	5	-	3

1.17.1.8 Generator current unbalance protection (option C1)

Settings relate to nominal generator current.

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1220	Current unbalance	Selection display	-	-	-	-
1221	Current unbalance	Set-point	0.0%	100.0%	-	30.0%
1222	Current unbalance	Timer	0.1 s	100.0 s	-	10.0 s
1223	Current unbalance	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1224	Current unbalance	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1225	Current unbalance	Enable	OFF	ON	RUN	OFF
1226	Current unbalance	Fail class	1	5	-	3

1.17.1.9 Generator voltage unbalance protection (option C1)

Settings relate to nominal generator voltage.

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1230	Voltage unbalance	Selection display	-	-	-	-
1231	Voltage unbalance	Set-point	0.0%	50.0%	-	10.0%
1232	Voltage unbalance	Timer	0.1 s	100.0 s	-	10.0 s
1233	Voltage unbalance	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1234	Voltage unbalance	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1235	Voltage unbalance	Enable	OFF	ON	RUN	OFF
1236	Voltage unbalance	Fail class	1	5	-	3

1.17.1.10 Generator reactive power import (loss of excitation) protection (option C1)

Settings relate to nominal generator power value (kW).

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1240	var import	Selection display	-	-	-	-
1241	var import	Set-point	0.0%	150.0%	-	50.0%
1242	var import	Timer	0.1 s	100.0 s	-	10.0 s
1243	var import	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1244	var import	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1245	var import	Enable	OFF	ON	RUN	OFF
1246	var import	Fail class	1	5	-	2

1.17.1.11 Generator reactive export (overexcitation) protection (option C1)

Settings relate to nominal generator power value (kW).

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1250	var export	Selection display	-	-	-	-
1251	var export	Set-point	0.0%	100.0%	-	60.0%
1252	var export	Timer	0.1 s	100.0 s	-	10.0 s
1253	var export	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1254	var export	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1255	var export	Enable	OFF	ON	RUN	OFF
1256	var export	Fail class	1	5	-	2

1.17.1.12 Loss of mains protection (option A)

The loss of mains protection includes df/dt (Rate Of Change Of Frequency) protection. The protection is used when the generator is paralleling with the mains. There is a fixed time delay of 1 second after the mains breaker closes to the protections are activated. The loss of mains function trips the mains breaker.

df/dt (ROCOF) (option A1/A2).

NOTE:
Time delay is in periods (per).

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1260	df/dt (ROCOF)	Selection display	-	-	-	-
1261	df/dt (ROCOF)	Set-point +/-	0.1 Hz/s	10.0 Hz/s	-	5.0 Hz/s
1262	df/dt (ROCOF)	Timer	1 per	20 per	-	6 per
1263	df/dt (ROCOF)	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1264	df/dt (ROCOF)	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1265	df/dt (ROCOF)	Enable	OFF	ON	RUN	OFF
1266	df/dt (ROCOF)	Fail class	1	6	-	6

Vector jump (option A1, A3).

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1270	Vector jump	Selection display	-	-	-	-
1271	Vector jump	Set-point	1.0 deg.	90.0 deg.	-	10.0 deg.
1272	Vector jump	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1273	Vector jump	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1274	Vector jump	Enable	OFF	ON	RUN	OFF
1275	Vector jump	Fail class	1	6	-	6

1.17.1.13 Engine control

The configuration of the engine interface card is done in the next channel groups. Configuration of the inputs is done through the display and the utility software.

1.17.1.14 Configurable (4…20 mA input 1 – set-point 1)

The input is not configurable in the peak shaving mode because it is used as a mains power input.

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1400	4…20 mA input 1.1	Selection display	-	-	-	-
1401	4…20 mA input 1.1	Set-point	4 mA	20 mA	-	10 mA
1402	4…20 mA input 1.1	Timer	0.0 s	600.0 s	-	120.0 s
1403	4…20 mA input 1.1	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1404	4…20 mA input 1.1	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1405	4…20 mA input 1.1	Enable	OFF	ON	RUN	OFF
1406	4…20 mA input 1.1	Fail class	1	5	-	2

1.17.1.15 Oil pressure (4…20 mA input 2 – set-point 1)

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1410	Oil pressure 1	Selection display	-	-	-	-
1411	Oil pressure 1	Set-point	0.0 bar	50.0 bar	-	6.0 bar
1412	Oil pressure 1	Timer	0.0 s	180.0 s	-	5.0 s
1413	Oil pressure 1	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1414	Oil pressure 1	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1415	Oil pressure 1	Enable	OFF	ON	RUN	OFF
1416	Oil pressure 1	Fail class	1	5	-	2

1.17.1.16 Low fuel (4…20 mA input 3 – set-point 1)

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1420	Fuel level 1	Selection display	-	-	-	-
1421	Fuel level 1	Set-point	0.0%	120.0%	-	20.0%
1422	Fuel level 1	Timer	0.0 s	600.0 s	-	120.0 s
1423	Fuel level 1	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1424	Fuel level 1	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1425	Fuel level 1	Enable	OFF	ON	RUN	OFF
1426	Fuel level 1	Fail class	1	5	-	2

1.17.1.17 Configurable (4…20 mA input 4 – set-point 1)

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1430	4…20 mA input 4.1	Selection display	-	-	-	-
1431	4…20 mA input 4.1	Set-point	4 mA	20 mA	-	10 mA
1432	4…20 mA input 4.1	Timer	0.2 s	100.0 s	-	10.0 s
1433	4…20 mA input 4.1	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1434	4…20 mA input 4.1	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1435	4…20 mA input 4.1	Enable	OFF	ON	RUN	OFF
1436	4…20 mA input 4.1	Fail class	1	5	-	2

1.17.1.18 Configurable (4...20 mA input 1 – set-point 2)

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1880	4…20 mA input 1.2	Selection display	-	-	-	-
1881	4…20 mA input 1.2	Set-point	4 mA	20 mA	-	10 mA
1882	4…20 mA input 1.2	Timer	0.0 s	600.0 s	-	120.0 s
1883	4…20 mA input 1.2	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1884	4…20 mA input 1.2	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1885	4…20 mA input 1.2	Enable	OFF	ON	RUN	OFF
1886	4…20 mA input 1.2	Fail class	1	5	-	2

1.17.1.19 Configurable (4...20 mA input 2 – set-point 2)

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1890	Oil pressure 2	Selection display	-	-	-	-
1891	Oil pressure 2	Set-point	4 mA	20 mA	-	10 mA
1892	Oil pressure 2	Timer	0.0 s	600.0 s	-	120.0 s
1893	Oil pressure 2	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1894	Oil pressure 2	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1895	Oil pressure 2	Enable	OFF	ON	RUN	OFF
1896	Oil pressure 2	Fail class	1	5	-	2

1.17.1.20 Configurable (4...20 mA input 3 – set-point 2)

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1900	Fuel level 2	Selection display	-	-	-	-
1901	Fuel level 2	Set-point	4 mA	20 mA	-	10 mA
1902	Fuel level 2	Timer	0.0 s	600.0 s	-	120.0 s
1903	Fuel level 2	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1904	Fuel level 2	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1905	Fuel level 2	Enable	OFF	ON	RUN	OFF
1906	Fuel level 2	Fail class	1	5	-	2

1.17.1.21 Configurable (4...20 mA input 4 – set-point 2)

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1910	4…20 mA input 4.2	Selection display	-	-	-	-
1911	4…20 mA input 4.2	Set-point	4 mA	20 mA	-	10 mA
1912	4…20 mA input 4.2	Timer	0.0 s	600.0 s	-	120.0 s
1913	4…20 mA input 4.2	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1914	4…20 mA input 4.2	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1915	4…20 mA input 4.2	Enable	OFF	ON	RUN	OFF
1916	4…20 mA input 4.2	Fail class	1	5	-	2

1.17.1.22 Water temperature (PT100 input 1 – set-point 1)

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1440	Water temp.	Selection display	-	-	-	-
1441	Water temp.	Set-point	-40°C	250°C	-	80°C
1442	Water temp.	Timer	0.0 s	5.0 s	-	180.0 s
1443	Water temp.	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1444	Water temp.	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1445	Water temp.	Enable	OFF	ON	RUN	OFF
1446	Water temp.	Fail class	1	5	-	2

1.17.1.23 Configurable (PT100 input 2 – set-point 1)

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1450	PT100 input 2	Selection display	-	-	-	-
1451	PT100 input 2	Set-point	-40°C	250°C	-	80°C
1452	PT100 input 2	Timer	0.2 s	100.0 s	-	10.0 s
1453	PT100 input 2	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1454	PT100 input 2	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1455	PT100 input 2	Enable	OFF	ON	RUN	OFF
1456	PT100 input 2	Fail class	1	5	-	2

1.17.1.24 Spare speed level

The spare speed level is an additional alarm point for the tacho input.

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1460	Spare speed level	Selection display	-	-	-	-
1461	Spare speed level	Set-point	1 RPM	4000 RPM	-	1450 RPM
1462	Spare speed level	Timer	0.0 s	100.0 s	-	5.0 s
1463	Spare speed level	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1464	Spare speed level	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1465	Spare speed level	Enable	OFF	ON	RUN	OFF
1466	Spare speed level	Fail class	1	5	-	2

1.17.1.25 Overspeed (tacho input)

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1470	Overspeed	Selection display	-	-	-	-
1471	Overspeed	Set-point	1 RPM	2000 RPM	-	1600 RPM
1472	Overspeed	Timer	0.2 s	100.0 s	-	15.0 s
1473	Overspeed	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1474	Overspeed	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1475	Overspeed	Enable	OFF	ON	RUN	OFF
1476	Overspeed	Fail class	1	5	-	5

1.17.1.26 Running detection

This set-point is used to define the level where the AGC recognises the gen-set as running. When this RPM level is reached, the automatic running detection is enabled, menu 1970.

Also take notice of the menu “Remove Starter” set-point, menu 4350.

No.	Setting		Min. setting	Max. setting	Factory setting
1480	Running detection	Selection display	-	-	-
1481	Running detection	Set-point	1 RPM	4000 RPM	1000 RPM

1.17.1.27 Ext. engine failure (binary input 8)

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1490	Engine failure	Selection display	-	-	-	-
1491	Engine failure	Timer	0.0 s	180.0 s	-	10.0 s
1492	Engine failure	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1493	Engine failure	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1494	Engine failure	Enable	OFF	ON	RUN	OFF
1495	Engine failure	Fail class	1	5	-	5

1.17.1.28 Ext. emergency stop (binary input 9)

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1500	Emergency STOP	Selection display	-	-	-	-
1501	Emergency STOP	Timer	0.0 s	60.0 s	-	2.0 s
1502	Emergency STOP	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1503	Emergency STOP	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1504	Emergency STOP	Enable	OFF	ON	RUN	OFF
1505	Emergency STOP	Fail class	1	5	-	2

1.17.1.29 Dig. input no. 10

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1510	Dig. input no. 10	Selection display	-	-	-	-
1511	Dig. input no. 10	Timer	0.0 s	100.0 s	-	10.0 s
1512	Dig. input no. 10	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1513	Dig. input no. 10	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1514	Dig. input no. 10	Enable	OFF	ON	RUN	OFF
1515	Dig. input no. 10	Fail class	1	5	-	2

1.17.1.30 Additional overcurrent alarms (option C1)

1.17.1.31 Fast overcurrent

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1520	Fast overcurr.	Selection display	-	-	-	-
1521	Fast overcurr.	Set-point	50.0%	200.0%	-	150.0%
1522	Fast overcurr.	Timer	0.0 s	100.0 s	-	0.0 s
1523	Fast overcurr.	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1524	Fast overcurr.	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1525	Fast overcurr.	Enable	OFF	ON	RUN	ON
1526	Fast overcurr.	Fail class	1	5	-	3

The “fast overcurrent alarm” is faster than 42 msec.

1.17.1.32 High overcurrent

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1530	High overcurr.	Selection display	-	-	-	-
1531	High overcurr.	Set-point	50.0%	200.0%	-	150.0%
1532	High overcurr.	Timer	0.1 s	100.0 s	-	1.0 s
1533	High overcurr.	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1534	High overcurr.	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1535	High overcurr.	Enable	OFF	ON	RUN	ON
1536	High overcurr.	Fail class	1	5	-	3

1.17.2 Configurable digital inputs (option M13)

1.17.2.1 Digital input no. 11

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1600	Dig. input no. 11	Selection display	-	-	-	-
1601	Dig. input no. 11	Timer	0.0 s	100.0 s	-	10.0 s
1602	Dig. input no. 11	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1603	Dig. input no. 11	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1604	Dig. input no. 11	Enable	OFF	ON	RUN	OFF
1605	Dig. input no. 11	Fail class	1	5	-	2

1.17.2.2 Digital input no. 12

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1610	Dig. input no. 12	Selection display	-	-	-	-
1611	Dig. input no. 12	Timer	0.0 s	100.0 s	-	10.0 s
1612	Dig. input no. 12	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1613	Dig. input no. 12	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1614	Dig. input no. 12	Enable	OFF	ON	RUN	OFF
1615	Dig. input no. 12	Fail class	1	5	-	2

1.17.2.3 Digital input no. 13

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1620	Dig. input no. 13	Selection display	-	-	-	-
1621	Dig. input no. 13	Timer	0.0 s	100.0 s	-	10.0 s
1622	Dig. input no. 13	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1623	Dig. input no. 13	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1624	Dig. input no. 13	Enable	OFF	ON	RUN	OFF
1625	Dig. input no. 13	Fail class	1	5	-	4

1.17.2.4 Digital input no. 14

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1630	Dig. input no. 14	Selection display	-	-	-	-
1631	Dig. input no. 14	Timer	0.0 s	100.0 s	-	10.0 s
1632	Dig. input no. 14	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1633	Dig. input no. 14	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1634	Dig. input no. 14	Enable	OFF	ON	RUN	OFF
1635	Dig. input no. 14	Fail class	1	5	-	2

1.17.2.5 Digital input no. 15

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1640	Dig. input no. 15	Selection display	-	-	-	-
1641	Dig. input no. 15	Timer	0.0 s	100.0 s	-	10.0 s
1642	Dig. input no. 15	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1643	Dig. input no. 15	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1644	Dig. input no. 15	Enable	OFF	ON	RUN	OFF
1645	Dig. input no. 15	Fail class	1	5	-	2

1.17.2.6 Digital input no. 16

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1650	Dig. input no. 16	Selection display	-	-	-	-
1651	Dig. input no. 16	Timer	0.0 s	100.0 s	-	10.0 s
1652	Dig. input no. 16	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1653	Dig. input no. 16	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1654	Dig. input no. 16	Enable	OFF	ON	RUN	OFF
1655	Dig. input no. 16	Fail class	1	5	-	2

1.17.2.7 Digital input no. 17

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1660	Dig. input no. 17	Selection display	-	-	-	-
1661	Dig. input no. 17	Timer	0.0 s	100.0 s	-	10.0 s
1662	Dig. input no. 17	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1663	Dig. input no. 17	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1664	Dig. input no. 17	Enable	OFF	ON	RUN	OFF
1665	Dig. input no. 17	Fail class	1	5	-	2

1.17.3 Configurable digital inputs (option M12)

***** R8 (relay 8): Refer to chapter 1.17 for max. relay setting.

1.17.3.1 Digital input no. 18

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1670	Dig. input no. 18	Selection display	-	-	-	-
1671	Dig. input no. 18	Timer	0.0 s	100.0 s	-	10.0 s
1672	Dig. input no. 18	Relay output A	R0 (none)	R8 (relay 8) *	-	R0 (none)
1673	Dig. input no. 18	Relay output B	R0 (none)	R8 (relay 8) *	-	R0 (none)
1674	Dig. input no. 18	Enable	OFF	ON	RUN	OFF
1675	Dig. input no. 18	Fail class	1	5	-	5

1.17.3.2 Digital input no. 19

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1680	Dig. input no. 19	Selection display	-	-	-	-
1681	Dig. input no. 19	Timer	0.0 s	100.0 s	-	10.0 s
1682	Dig. input no. 19	Relay output A	R0 (none)	R8 (relay 8) *	-	R0 (none)
1683	Dig. input no. 19	Relay output B	R0 (none)	R8 (relay 8) *	-	R0 (none)
1684	Dig. input no. 19	Enable	OFF	ON	RUN	OFF
1685	Dig. input no. 19	Fail class	1	5	-	2

1.17.3.3 Digital input no. 20

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1690	Dig. input no. 20	Selection display	-	-	-	-
1691	Dig. input no. 20	Timer	0.0 s	100.0 s	-	10.0 s
1692	Dig. input no. 20	Relay output A	R0 (none)	R8 (relay 8) *	-	R0 (none)
1693	Dig. input no. 20	Relay output B	R0 (none)	R8 (relay 8) *	-	R0 (none)
1694	Dig. input no. 20	Enable	OFF	ON	RUN	OFF
1695	Dig. input no. 20	Fail class	1	5	-	2

1.17.3.4 Digital input no. 21

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1700	Dig. input no. 21	Selection display	-	-	-	-
1701	Dig. input no. 21	Timer	0.0 s	100.0 s	-	10.0 s
1702	Dig. input no. 21	Relay output A	R0 (none)	R8 (relay 8) *	-	R0 (none)
1703	Dig. input no. 21	Relay output B	R0 (none)	R8 (relay 8) *	-	R0 (none)
1704	Dig. input no. 21	Enable	OFF	ON	RUN	OFF
1705	Dig. input no. 21	Fail class	1	5	-	2

1.17.3.5 Digital input no. 22

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1710	Dig. input no. 22	Selection display	-	-	-	-
1711	Dig. input no. 22	Timer	0.0 s	100.0 s	-	10.0 s
1712	Dig. input no. 22	Relay output A	R0 (none)	R8 (relay 8) *	-	R0 (none)
1713	Dig. input no. 22	Relay output B	R0 (none)	R8 (relay 8) *	-	R0 (none)
1714	Dig. input no. 22	Enable	OFF	ON	RUN	OFF
1715	Dig. input no. 22	Fail class	1	5	-	2

1.17.3.6 Digital input no. 23

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1720	Dig. input no. 23	Selection display	-	-	-	-
1721	Dig. input no. 23	Timer	0.0 s	100.0 s	-	10.0 s
1722	Dig. input no. 23	Relay output A	R0 (none)	R8 (relay 8) *	-	R0 (none)
1723	Dig. input no. 23	Relay output B	R0 (none)	R8 (relay 8) *	-	R0 (none)
1724	Dig. input no. 23	Enable	OFF	ON	RUN	OFF
1725	Dig. input no. 23	Fail class	1	5	-	5

1.17.3.7 Digital input no. 24

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1730	Dig. input no. 24	Selection display	-	-	-	-
1731	Dig. input no. 24	Timer	0.0 s	100.0 s	-	10.0 s
1732	Dig. input no. 24	Relay output A	R0 (none)	R8 (relay 8) *	-	R0 (none)
1733	Dig. input no. 24	Relay output B	R0 (none)	R8 (relay 8) *	-	R0 (none)
1734	Dig. input no. 24	Enable	OFF	ON	RUN	OFF
1735	Dig. input no. 24	Fail class	1	5	-	2

1.17.3.8 Digital input no. 25

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1740	Dig. input no. 25	Selection display	-	-	-	-
1741	Dig. input no. 25	Timer	0.0 s	100.0 s	-	10.0 s
1742	Dig. input no. 25	Relay output A	R0 (none)	R8 (relay 8) *	-	R0 (none)
1743	Dig. input no. 25	Relay output B	R0 (none)	R8 (relay 8) *	-	R0 (none)
1744	Dig. input no. 25	Enable	OFF	ON	RUN	OFF
1745	Dig. input no. 25	Fail class	1	5	-	2

1.17.3.9 Digital input no. 26

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1750	Dig. input no. 26	Selection display	-	-	-	-
1751	Dig. input no. 26	Timer	0.0 s	100.0 s	-	10.0 s
1752	Dig. input no. 26	Relay output A	R0 (none)	R8 (relay 8) *	-	R0 (none)
1753	Dig. input no. 26	Relay output B	R0 (none)	R8 (relay 8) *	-	R0 (none)
1754	Dig. input no. 26	Enable	OFF	ON	RUN	OFF
1755	Dig. input no. 26	Fail class	1	5	-	2

1.17.3.10 Digital input no. 27

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1760	Dig. input no. 27	Selection display	-	-	-	-
1761	Dig. input no. 27	Timer	0.0 s	100.0 s	-	10.0 s
1762	Dig. input no. 27	Relay output A	R0 (none)	R8 (relay 8) *	-	R0 (none)
1763	Dig. input no. 27	Relay output B	R0 (none)	R8 (relay 8) *	-	R0 (none)
1764	Dig. input no. 27	Enable	OFF	ON	RUN	OFF
1765	Dig. input no. 27	Fail class	1	5	-	2

1.17.3.11 Digital input no. 28

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1770	Dig. input no. 28	Selection display	-	-	-	-
1771	Dig. input no. 28	Timer	0.0 s	100.0 s	-	10.0 s
1772	Dig. input no. 28	Relay output A	R0 (none)	R8 (relay 8) *	-	R0 (none)
1773	Dig. input no. 28	Relay output B	R0 (none)	R8 (relay 8) *	-	R0 (none)
1774	Dig. input no. 28	Enable	OFF	ON	RUN	OFF
1775	Dig. input no. 28	Fail class	1	5	-	4

1.17.3.12 Digital input no. 29

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1780	Dig. input no. 29	Selection display	-	-	-	-
1781	Dig. input no. 29	Timer	0.0 s	100.0 s	-	10.0 s
1782	Dig. input no. 29	Relay output A	R0 (none)	R8 (relay 8) *	-	R0 (none)
1783	Dig. input no. 29	Relay output B	R0 (none)	R8 (relay 8) *	-	R0 (none)
1784	Dig. input no. 29	Enable	OFF	ON	RUN	OFF
1785	Dig. input no. 29	Fail class	1	5	-	2

1.17.3.13 Digital input no. 30

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1790	Dig. input no. 30	Selection display	-	-	-	-
1791	Dig. input no. 30	Timer	0.0 s	100.0 s	-	10.0 s
1792	Dig. input no. 30	Relay output A	R0 (none)	R8 (relay 8) *	-	R0 (none)
1793	Dig. input no. 30	Relay output B	R0 (none)	R8 (relay 8) *	-	R0 (none)
1794	Dig. input no. 30	Enable	OFF	ON	RUN	OFF
1795	Dig. input no. 30	Fail class	1	5	-	2

1.17.4 Configurable analogue inputs (option M15)

***** R0 (none): Refer to chapter 1.17 for max. relay setting.

1.17.4.1 Configurable (4…20 mA input 5 – set-point 1)

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1800	4…20 mA input 5	Selection display	-	-	-	-
1801	4…20 mA input 5	Set-point	4 mA	20 mA	-	10 mA
1802	4…20 mA input 5	Timer	0.0 s	600.0 s	-	120.0 s
1803	4…20 mA input 5	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1804	4…20 mA input 5	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1805	4…20 mA input 5	Enable	OFF	ON	RUN	OFF
1806	4…20 mA input 5	Fail class	1	5	-	2

1.17.4.2 Configurable (4…20 mA input 6 – set-point 1)

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1810	4…20 mA input 6	Selection display	-	-	-	-
1811	4…20 mA input 6	Set-point	4 mA	20 mA	-	10 mA
1812	4…20 mA input 6	Timer	0.0 s	600.0 s	-	120.0 s
1813	4…20 mA input 6	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1814	4…20 mA input 6	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1815	4…20 mA input 6	Enable	OFF	ON	RUN	OFF
1816	4…20 mA input 6	Fail class	1	5	-	2

1.17.4.3 Configurable (4…20 mA input 7 – set-point 1)

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1820	4…20 mA input 7	Selection display	-	-	-	-
1821	4…20 mA input 7	Set-point	4 mA	20 mA	-	10 mA
1822	4…20 mA input 7	Timer	0.0 s	600.0 s	-	120.0 s
1823	4…20 mA input 7	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1824	4…20 mA input 7	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1825	4…20 mA input 7	Enable	OFF	ON	RUN	OFF
1826	4…20 mA input 7	Fail class	1	5	-	2

1.17.4.4 Configurable (4…20 mA input 8 – set-point 1)

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1830	4…20 mA input 8	Selection display	-	-	-	-
1831	4…20 mA input 8	Set-point	4 mA	20 mA	-	10 mA
1832	4…20 mA input 8	Timer	0.0 s	600.0 s	-	120.0 s
1833	4…20 mA input 8	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1834	4…20 mA input 8	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1835	4…20 mA input 8	Enable	OFF	ON	RUN	OFF
1836	4…20 mA input 8	Fail class	1	5	-	2

1.17.4.5 Configurable (4…20 mA input 5 – set-point 2)

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1840	4…20 mA input 5	Selection display	-	-	-	-
1841	4…20 mA input 5	Set-point	4 mA	20 mA	-	10 mA
1842	4…20 mA input 5	Timer	0.0 s	600.0 s	-	120.0 s
1843	4…20 mA input 5	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1844	4…20 mA input 5	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1845	4…20 mA input 5	Enable	OFF	ON	RUN	OFF
1846	4…20 mA input 5	Fail class	1	5	-	2

1.17.4.6 Configurable (4…20 mA input 6 – set-point 2)

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1850	4…20 mA input 6	Selection display	-	-	-	-
1851	4…20 mA input 6	Set-point	4 mA	20 mA	-	10 mA
1852	4…20 mA input 6	Timer	0.0 s	600.0 s	-	120.0 s
1853	4…20 mA input 6	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1854	4…20 mA input 6	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1855	4…20 mA input 6	Enable	OFF	ON	RUN	OFF
1856	4…20 mA input 6	Fail class	1	5	-	2

1.17.4.7 Configurable (4…20 mA input 7 – set-point 2)

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1860	4…20 mA input 7	Selection display	-	-	-	-
1861	4…20 mA input 7	Set-point	4 mA	20 mA	-	10 mA
1862	4…20 mA input 7	Timer	0.0 s	600.0 s	-	120.0 s
1863	4…20 mA input 7	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1864	4…20 mA input 7	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1865	4…20 mA input 7	Enable	OFF	ON	RUN	OFF
1866	4…20 mA input 7	Fail class	1	5	-	2

1.17.4.8 Configurable (4…20 mA input 8 – set-point 2)

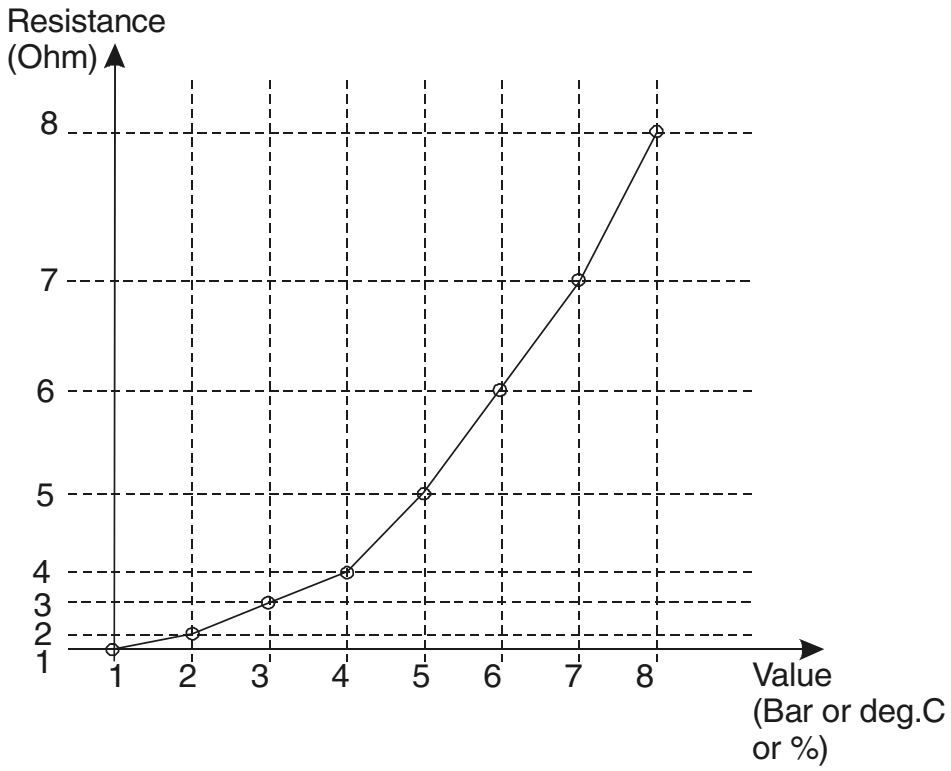
No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
1870	4…20 mA input 8	Selection display	-	-	-	-
1871	4…20 mA input 8	Set-point	4 mA	20 mA	-	10 mA
1872	4…20 mA input 8	Timer	0.0 s	600.0 s	-	120.0 s
1873	4…20 mA input 8	Relay output A	R0 (none)	R0 (none) *	-	R0 (none)
1874	4…20 mA input 8	Relay output B	R0 (none)	R0 (none) *	-	R0 (none)
1875	4…20 mA input 8	Enable	OFF	ON	RUN	OFF
1876	4…20 mA input 8	Fail class	1	5	-	2

1.17.5 VDO inputs (option M2 only)

As there are different types of VDO resistor sensors, the settings of a curve must be made. This curve is made by defining 8 break points for each sensor, enabling different characteristics to be used.

The 3 inputs are pre-defined, for pressure (1), temperature (2) and fuel tank level (3). The name texts can be changed in the PC utility software.

Curve:



NOTE:
The 8 curve settings for VDO no. 1, 2 and 3 cannot be changed in the display, **only** in the PC utility software. The alarm settings can be changed both in display and PC utility software.

1.17.6 VDO sensor 1, alarm settings

No.	Setting		Min. setting	Max. setting	Factory setting
1920	VDO 1.1	Selection display	-	-	-
1921	VDO 1.1	Set-point	0.0 bar	10.0 bar	4.0 bar
1922	VDO 1.1	Delay	0.0 s	100.0 s	5.0 s
1923	VDO 1.1	Output A	R0 (none)	R0 (none) *	R0 (none)
1924	VDO 1.1	Output B	R0 (none)	R0 (none) *	R0 (none)
1925	VDO 1.1	Enable	OFF	ON	OFF
1926	VDO 1.1	Fail class	1	5	2

Text (VDO 1.1) can be changed using the PC utility software.

No.	Setting		Min. setting	Max. setting	Factory setting
1930	VDO 1.2	Selection display	-	-	-
1931	VDO 1.2	Set-point	0.0 bar	10.0 bar	5.0 bar
1932	VDO 1.2	Delay	0.0 s	100.0 s	5.0 s
1933	VDO 1.2	Output A	R0 (none)	R0 (none) *	R0 (none)
1934	VDO 1.2	Output B	R0 (none)	R0 (none) *	R0 (none)
1935	VDO 1.2	Enable	OFF	ON	OFF
1936	VDO 1.2	Fail class	1	5	2

Text (VDO 1.2) can be changed using the PC utility software.

1.17.7 VDO sensor 2, alarm settings

No.	Setting		Min. setting	Max. setting	Factory setting
1940	VDO 2.1	Selection display	-	-	-
1941	VDO 2.1	Set-point	0.0 bar	10.0 bar	4.0 bar
1942	VDO 2.1	Delay	0.0 s	100.0 s	5.0 s
1943	VDO 2.1	Output A	R0 (none)	R0 (none) *	R0 (none)
1944	VDO 2.1	Output B	R0 (none)	R0 (none) *	R0 (none)
1945	VDO 2.1	Enable	OFF	ON	OFF
1946	VDO 2.1	Fail class	1	5	2

Text (VDO 2.1) can be changed using the PC utility software.

No.	Setting		Min. setting	Max. setting	Factory setting
1950	VDO 2.2	Selection display	-	-	-
1951	VDO 2.2	Set-point	0.0 bar	10.0 bar	4.0 bar
1952	VDO 2.2	Delay	0.0 s	100.0 s	5.0 s
1953	VDO 2.2	Output A	R0 (none)	R0 (none) *	R0 (none)
1954	VDO 2.2	Output B	R0 (none)	R0 (none) *	R0 (none)
1955	VDO 2.2	Enable	OFF	ON	OFF
1956	VDO 2.2	Fail class	1	5	2

Text (VDO 2.2) can be changed using the PC utility software.

1.17.8 VDO, fuel level

No.	Setting		Min. setting	Max. setting	Factory setting
1960	Fuel level	Selection display	-	-	-
1961	Fuel level	Set-point	0%	100%	10%
1962	Fuel level	Delay	0.0 s	100.0 s	10.0 s
1963	Fuel level	Output A	R0 (none)	R0 (none) *	R0 (none)
1964	Fuel level	Output B	R0 (none)	R0 (none) *	R0 (none)
1965	Fuel level	Enable	OFF	ON	OFF
1966	Fuel level	Fail class	1	5	2

1.17.8.1 Running status

The running status detection has two purposes:

1. After the time delay expires all the alarms above which are selected to “RUN” will be enabled.

2. An output relay can be selected if available. In that case the settings Output A and Output B must be selected to the desired relay; typically the function of this relay must be selected to “Limit” function to avoid a “RUN STATUS ALARM” when the gen-set starts. Refer to menus 4600 ff.

No.	Setting		Min. setting	Max. setting	Factory setting
1970	Run status	Selection display	-	-	-
1971	Run status	Timer	0.0 s	60.0 s	5.0 s
1972	Run status	Relay output A	R0 (none)	R0 (none) *	R0 (none)
1973	Run status	Relay output B	R0 (none)	R0 (none) *	R0 (none)
1974	Run status	Enable	OFF	ON	OFF

1.17.9 Control setup

***** R0 (none): Refer to chapter 1.17 for max. relay setting.

1.17.9.1 Synchronisation type

No.	Setting		First setting	Second setting	Factory setting
2010	Sync. type	Selection display	-	-	-
2011	Sync. type	Sync. type	Static sync.	Dynamic sync.	Dynamic sync.

If dynamic synchronisation is chosen, the next menu will be 2020. If static synchronisation is chosen, the next menu will be 2030.

1.17.9.2 Dynamic synchronisation

The setting of df max. and df min. decides whether the generator synchronises when running faster or slower than nominal frequency.

The “dU max.” setting is related to nominal generator voltage. The “dU max.“ setting is +/- nominal generator voltage.

The multi-line 2 compensates for the breaker delay time when synchronising.

No.	Setting		Min. setting	Max. setting	Factory setting
2020	Dynamic sync.	Selection display	-	-	-
2021	Dynamic sync.	df max.	0.0 Hz	0.5 Hz	0.3 Hz
2022	Dynamic sync.	df min.	-0.5 Hz	0.5 Hz	0.0 Hz
2023	Dynamic sync.	dU max.	2%	10%	5%
2024	Dynamic sync.	Breaker delay	40 ms	300 ms	50 ms

The synchronisation pulse is 400 ms.

1.17.9.3 Static synchronisation

The following parameters are used for the static synchronisation:

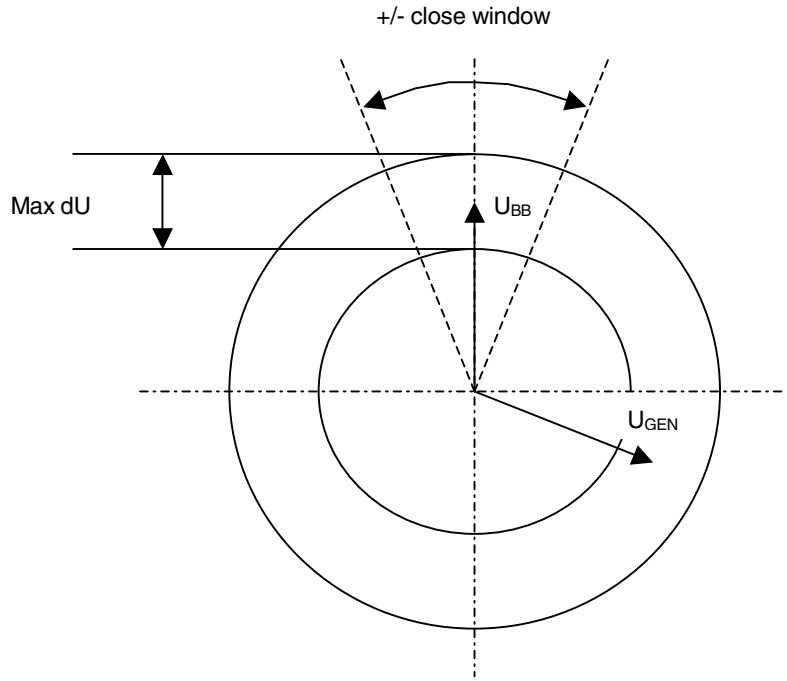
Setting	Description	Note
Maximum df	The maximum allowed frequency difference between the busbar/mains and the generator	+/- value
Maximum dU	The maximum allowed voltage difference between the busbar/mains and the generator	+/- value, related to the generator nominal voltage (setting 4014)
Close window	The size of the window where the synchronisation pulse can be released	+/- value
Phase K_P	Adjustment of the proportional factor of the PI phase controller	Only used during static synchronisation
Phase K_I	Adjustment of the integral factor of the PI phase controller	

No.	Setting		Min. setting	Max. setting	Factory setting
2030	Static sync.	Selection display	-	-	-
2031	Static sync.	Maximum df	0.00 Hz	1.00 Hz	0.25 Hz
2032	Static sync.	Maximum dU	2%	10%	5%
2033	Static sync.	Close window	0.1 deg.	20.0 deg.	10.0 deg.
2034	Static sync.	Phase K_P	0	400	250
2035	Static sync.	Phase K_I	0	400	160

Refer to paragraph 1.17.10 for further explanation of the PI controller settings (K_P and K_I).

The synchronisation pulse is 400 ms.

Synchronisation will happen when the generator voltage is within the close window and the frequency difference is within the df and dU settings. (See illustration on the next page).



1.17.9.4 Blackout closing of breaker

Settings are accepted limits (generator voltage and frequency) for closing the generator breaker. The “dU max.” setting is related to nominal generator voltage.

No.	Setting		Min. setting	Max. setting	Factory setting
2050	Sync. blackout	Selection display	-	-	-
2051	Sync. blackout	df max.	0.0 Hz	5.0 Hz	3.0 Hz
2052	Sync. blackout	dU max.	2%	10%	5%

If blackout closing of breaker is enabled on more units, external precautions must be taken to avoid two or more generators closing on a black busbar. In that case synchronism will not be present.

1.17.9.5 Generator and mains breaker, general failure alarm

- Synchronisation time — Adjustable time delay channel 2061/2071
- Breaker ON/OFF feedback fail — 1 second fixed time delay
- Phase sequence error — 1 second fixed time delay

No.	Setting		Min. setting	Max. setting	Factory setting
2060	GB general fail.	Selection display	-	-	-
2061	GB general fail.	Delay	30.0 s	300.0 s	60.0 s
2062	GB general fail.	Relay output A	R0 (none)	R0 (none) *	R0 (none)
2063	GB general fail.	Relay output B	R0 (none)	R0 (none) *	R0 (none)

No.	Setting		Min. setting	Max. setting	Factory setting
2070	MB general fail.	Selection display	-	-	-
2071	MB general fail.	Delay	30.0 s	300.0 s	60.0 s
2072	MB general fail.	Relay output A	R0 (none)	R0 (none) *	R0 (none)
2073	MB general fail.	Relay output B	R0 (none)	R0 (none) *	R0 (none)

The general failure alarms cannot be disabled.

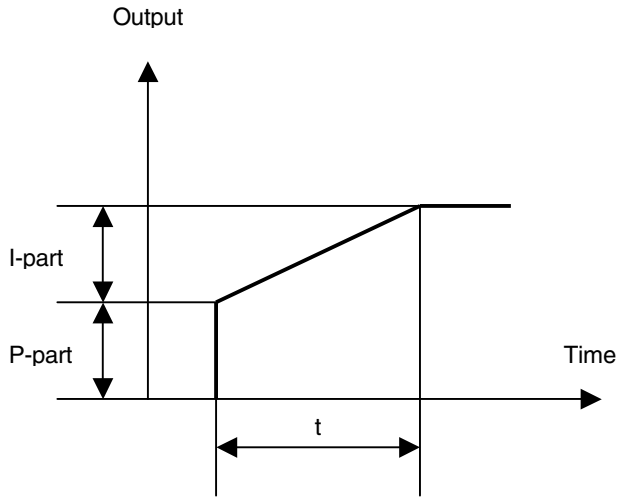
1.17.10 PI controller, K_P and K_I adjustments

The AGC includes controllers for the different running modes. The controllers control either a relay output or an analogue output (option).

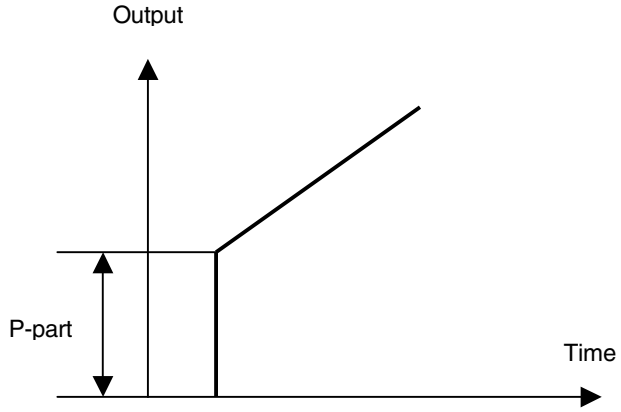
Each controller consists of a proportional factor, K_P, and an integral factor, K_I.

The proportional factor, K_P, decides the size of the proportional part at a regulation deviation, and the integral factor, K_I, decides the integral part. The individual function of K_P and K_I is described in the drawings on the next page. The drawings show the change of the output when the input value deviates from the set-point, e.g. because of a frequency change.

Drawing 1

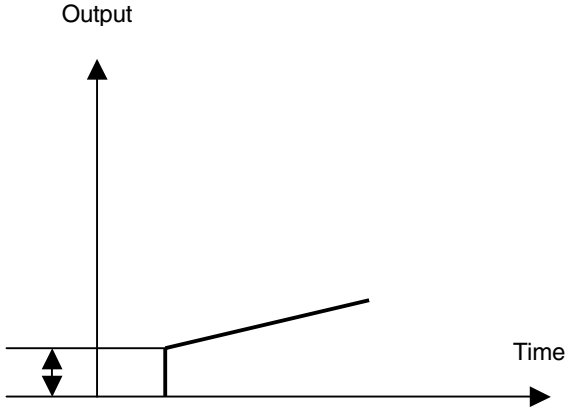


Drawing 2, high K_P setting



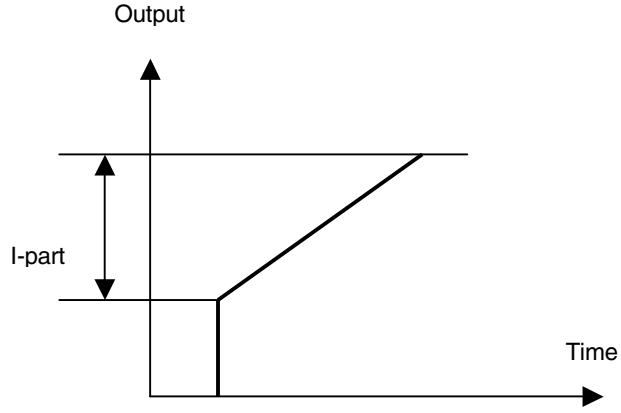
The P-part of the output can be changed by changing the K_P factor. Increasing K_P increases the P-part.

Drawing 3, low K_P setting



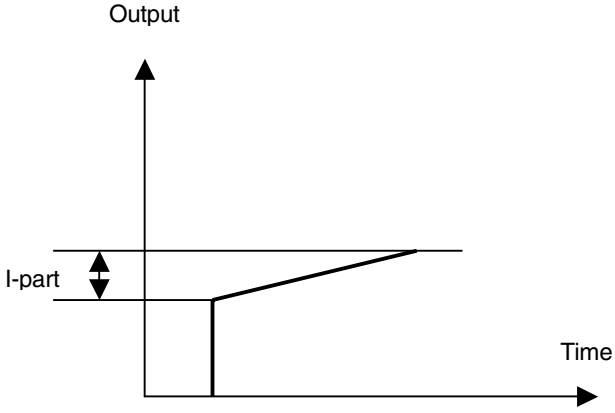
The P-part of the output can be changed by changing the K_P factor. Decreasing K_P decreases the P-part of the regulation.

Drawing 4, high K_I setting



The I-part of the output can be changed by changing the K_I factor. Increasing the K_I factor makes the regulation faster.

Drawing 5, low K_I setting



The I-part of the output can be changed by changing the K_I factor. Decreasing the K_I factor makes the regulation slower.

1.17.10.1 Frequency controller

Frequency % settings relate to nominal generator frequency (setting 4011). It is used for frequency control (fixed frequency or load sharing) when the breaker is closed, and for synchronising if the breaker is open.

No.	Setting		Min. setting	Max. setting	Factory setting
2090	Freq. control	Selection display	-	-	-
2091	Freq. control	Deadband	0.2%	10.0%	1.0%
2092	Freq. control	F K_P	0	1000	250
2093	Freq. control	F K_I	0	1000	160

1.17.10.2 Power controller

Power % settings relate to nominal generator power.

No.	Setting		Min. setting	Max. setting	Factory setting
2100	Power control	Selection display	-	-	-
2101	Power control	Deadband	0.2%	10.0%	2.0%
2102	Power control	P K_P	0	1000	250
2103	Power control	P K_I	0	1000	160

1.17.10.3 Power ramp up

The delay point and time is the point where the generator stops ramping after closing of generator breaker to pre-heat the engine before commencing to take load. The time duration of the point is determined by the delay time setting. If the delay function is not needed, set the time to 0.

Power % settings relate to nominal generator power.

No.	Setting		Min. setting	Max. setting	Factory setting
2110	Power ramp up	Selection display	-	-	-
2111	Power ramp up	Speed	1.0%/s	20.0%/s	2.0%/s
2112	Power ramp up	Delay point	1%	100%	10%
2113	Power ramp up	Delay time	0.0 s	180.0 s	10.0 s

1.17.10.4 Power ramp down

The breaker open point is where a relay output is activated to open the generator breaker before reaching 0 kW.

Power % settings relate to nominal generator power.

No.	Setting		Min. setting	Max. setting	Factory setting
2120	Power ramp down	Selection display	-	-	-
2121	Power ramp down	Speed	0.1%/s	20.0%/s	10.0%/s
2122	Power ramp down	Breaker open set-point	1%	20%	5%

1.17.10.5 Voltage controller (option D)

The ON/integral time is a combined setting. If relay voltage control setting is used, the setting indicates the shortest relay ON time. If the voltage control setting is analogue output (option E), the setting is for the PI controller integral time.

The voltage controller is active when the generator is in island mode.
Voltage deadband % settings relate to nominal generator voltage.

No.	Setting		Min. setting	Max. setting	Factory setting
2140	Voltage control	Selection display	-	-	-
2141	Voltage control	Deadband	0.0%	10.0%	2.0%
2142	Voltage control	U K_P	0	1000	250
2143	Voltage control	U K_I	0	1000	160

1.17.10.6 var controller (option D)

The ON/integral time is a combined setting. If relay var control setting is used, the setting indicates the shortest relay ON time. If the var control setting is analogue output (option), the setting is for the PI controller integral time.

var deadband % settings relate to nominal generator power value, i.e. it is assumed that the generator var value is the same as the kW value. This is not correct, but the assumption is made for control purposes only.
The var controller is active when the generator is parallel to mains controlling the PF.

No.	Setting		Min. setting	Max. setting	Factory setting
2150	var control	Selection display	-	-	-
2151	var control	Deadband	0.0%	10.0%	2.0%
2152	var control	Q K_P	0	1000	250
2153	var control	Q K_I	0	1000	160

1.17.10.7 Governor/AVR regulation failure

The alarms are activated if the difference between the measured value and the set-point is outside the deadband for longer than the timer set-point.

No.	Setting		Min. setting	Max. setting	Factory setting
2180	Governor reg. failure	Selection display	-	-	-
2181	Governor reg. failure	Deadband	1.0%	100.0%	30.0%
2182	Governor reg. failure	Timer	10.0 s	360.0 s	60.0 s
2183	Governor reg. failure	Output A	R0 (none)	R0 (none) *	R0 (none)
2184	Governor reg. failure	Output B	R0 (none)	R0 (none) *	R0 (none)

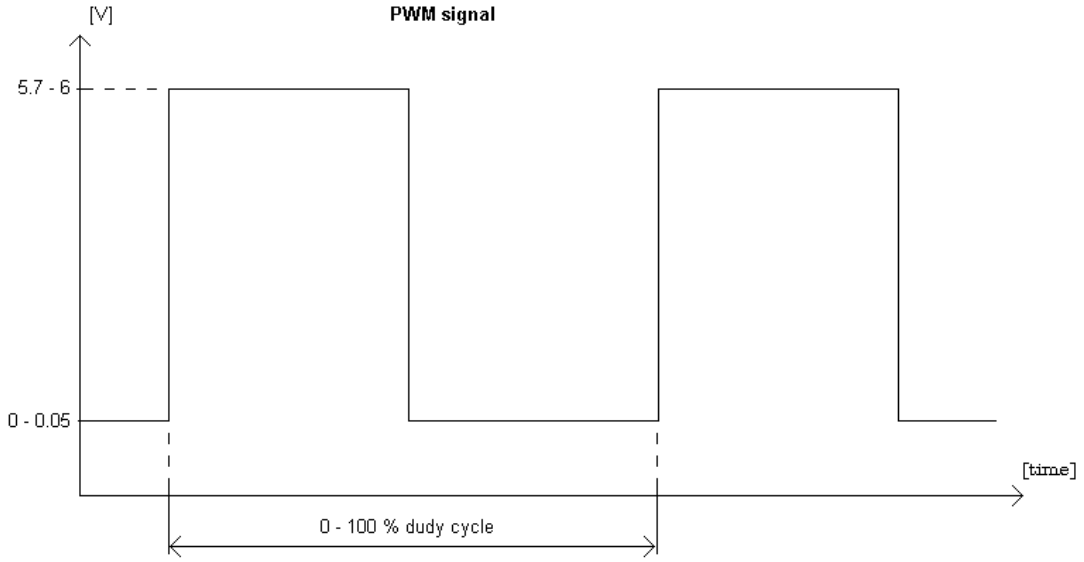
No.	Setting		Min. setting	Max. setting	Factory setting
2190	AVR reg. failure	Selection display	-	-	-
2191	AVR reg. failure	Deadband	1.0%	100.0%	30.0%
2192	AVR reg. failure	Timer	10.0 s	360.0 s	60.0 s
2193	AVR reg. failure	Output A	R0 (none)	R0 (none) *	R0 (none)
2194	AVR reg. failure	Output B	R0 (none)	R0 (none) *	R0 (none)

1.17.10.8 Pulse with modulation

No.	Setting		Min. setting	Max. setting	Factory setting
2200	PWM control	Selection display	-	-	-
2201	PWM control	Minimum value	0.0%	50.0%	10.0%
2202	PWM control	Init. value	0.0%	100.0%	35.0%
2203	PWM control	Maximum value	50.0%	100.0%	90.0%
2204	PWM control	Enable	OFF	ON	OFF
2205	PWM control	Droop duty cycle	0.0%	100.0%	50.0%

These are the settings for the PWM output:

- (2201) PWM min. This is the minimum output level of the PWM signal. Default it is set to 10%.
- (2202) PWM init. This is the initial output level which is the level where the PWM signal will start the regulation. Default it is set to 35%.
- (2203) PWM max. This is the maximum output level of the PWM signal. Default it is set to 90%.
- (2204) Enable. This sets the PWM on or off. If it is disabled the PWM output PCB will work as option EF4 (see option EF4 below), until it is enabled again. Default setting of the output is enabled (ON).
- (2205) Droop duty cycle. The second PWM output must be used to let the cat governor operate in speed droop.



The PWM signal has a frequency of 500 +/-50Hz. The resolution of the duty cycle is 12 bits which gives the output 4095 different levels. The output is an open collector output with a 1k-ohm pull-up resistor.

The low level of the signal is between 0 and 0.05 volt and the high level is between 5.7 and 6 volt.

If the PWM control is disabled, the channel group 2210 is displayed.

1.17.10.9 Governor/AVR setup

No.	Setting		Min. setting	Max. setting	Factory setting
2210	GOV/AVR setup	Selection display	-	-	-
2211	Type	Type	GOV = Ana AVR = Bin	GOV = Bin AVR = Ana	GOV = Ana AVR = Bin

Channel 2210 is only available if the PWM output is OFF in channel 2204.

1.17.11 PI controllers, relay outputs

The relay outputs are made as a PWM (Pulse Width Modulated) output. That means that the time between relay ON points remains constant, whereas the relay ON time varies between constant (far away from set-point) and lowest value (close to set-point).

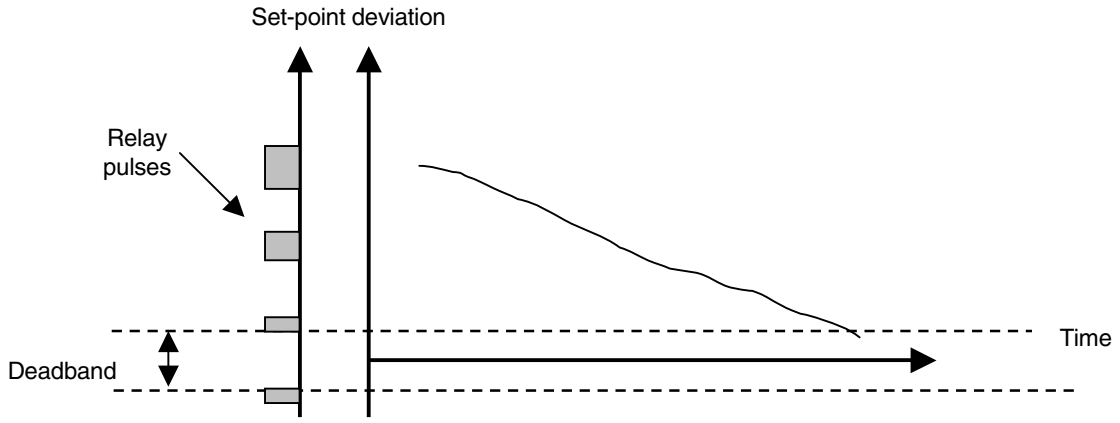
If relay outputs are used, it is necessary to adjust a relay minimum ON time and a regulation period time. This adjustment can be done on both the GOV and the AVR outputs. Diagrams 6 and 7 show the principle of the relay control.

When using relay control outputs it is also necessary to tune in the PI controller set-points, K_P and K_I. Higher value (for both) = faster (and more unstable) control.

This setting is used to tune in the GOV ON time when relay outputs are being used for control. The total relay ON time will depend on the deviation from the set-point. t_N is the minimum time the relay can be activated.

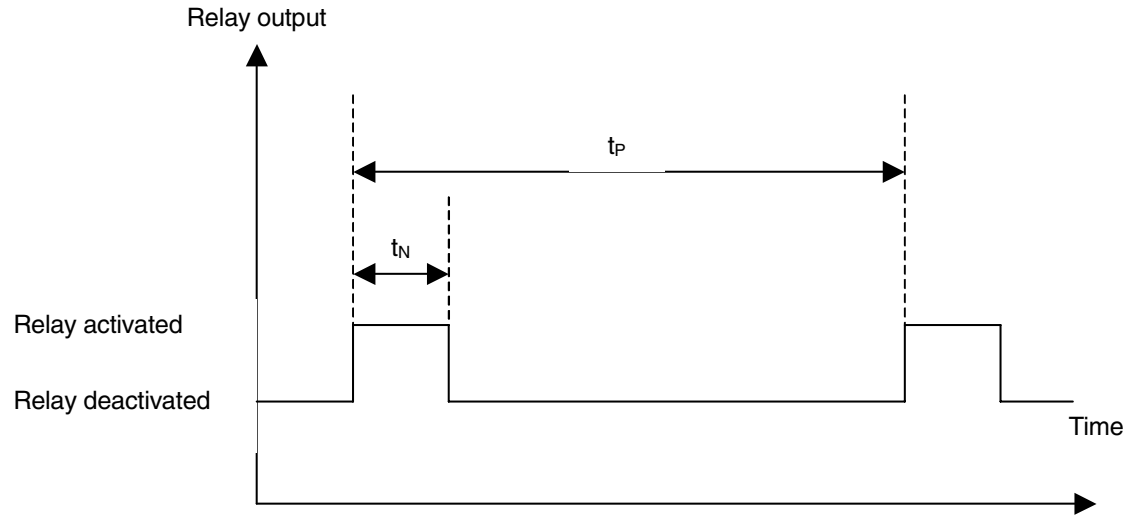
No.	Setting		Min. setting	Max. setting	Factory setting
2230	Relay control	Selection display	-	-	-
2231	Relay control	GOV ON time t_N	10 ms	6500 ms	500 ms
2232	Relay control	GOV per. time t_P	50 ms	32500 ms	2500 ms
2233	Relay control	AVR ON time t_N	10 ms	3000 ms	100 ms
2234	Relay control	AVR per. time t_P	50 ms	15000 ms	500 ms

Diagram 6, relay control signals



The diagram shows that the length of the relay pulses is depending on the deviation from the set-point. The minimum relay output (close to the deadband) is equal to the setting t_N, the maximum relay output is constantly ON.

Diagram 7, relay control signals



1.17.11.1 Governor offset adjustment

This adjustment is used to make an offset on the analogue governor output. The value is reached in two ways:

1. The input “reset analogue GOV output” is activated
2. The AGC is powered up

No.	Setting		Min. setting	Max. setting	Factory setting
2240	Analogue GOV	Selection display	-	-	-
2241	Analogue GOV	Offset	-100%	100%	0%

1.17.11.2 AVR offset adjustment

This adjustment is used to make an offset on the analogue governor output. The value is reached when the AGC is powered up.

No.	Setting		Min. setting	Max. setting	Factory setting
2250	Analogue AVR	Selection display	-	-	-
2251	Analogue AVR	Offset	-100%	100%	0%

1.17.12 Power setup

This setup menu describes various settings of different gen-set modes:

Gen-set mode	Menu numbers	Menu text
Peak shaving	3010	Mains power import
	3020	Daytime period
	3030	Start generator
	3040	Stop generator
Test	3070	Test
Fixed power	3080	Fixed power set-point
Fixed mains power export	3090	Mains power export
	3100	Start gen.
	3110	Stop gen.

1.17.12.1 Mains import power, peak shaving

The mains power set-point is the maximum imported power from the mains. If the load is higher than this set-point, the mains will supply the load equal to the mains power set-point and the gen-set will supply all additional load.

It is possible to have two set-points, a daytime and a nighttime set-point. The purpose of this is to adapt the mains import to the different load conditions in different periods.

The AGC needs a 4...20 mA signal on terminal 98-99 from a power transducer, measuring the imported power from the mains. The calibration of the power transducer must be:

- 4 mA = 0.0 MW
- 20 mA = Transducer scale, set-point in channel 3013

No.	Setting		Min. setting	Max. setting	Factory setting
3010	Mains power	Selection display	-	-	-
3011	Mains power	Day	0 kW	20000 kW	750 kW
3012	Mains power	Night	0 kW	20000 kW	1000 kW
3013	Mains power	Transducer scale	0 kW	20000 kW	1500 kW

1.17.12.2 Daytime period

The start/stop time of the daytime period is adjusted with hours and minutes. The period outside the daytime period is defined as the nighttime period.

No.	Setting		Min. setting	Max. setting	Factory setting
3020	Daytime period	Selection display	-	-	-
3021	Daytime period	Start hour	0	23	8
3022	Daytime period	Start minute	0	59	0
3023	Daytime period	Stop hour	0	23	16
3024	Daytime period	Stop minute	0	59	0

1.17.12.3 Start gen-set

The set-point is used to start the gen-set. When the imported mains power exceeds the set-point in channel 3031, the gen-set is started and synchronised to the busbar. The set-point in channel 3031 is referring to the mains power set-points in channel 3011 or 3012. The start generator minimum load point is the minimum loading of the gen-set. The mains will always supply the maximum possible power. The additional power will be supplied by the gen-set.

No.	Setting		Min. setting	Max. setting	Factory setting
3030	Start generator	Selection display	-	-	-
3031	Start generator	Set-point	20%	100%	80%
3032	Start generator	Timer	0.0 s	990.0 s	10.0 s
3033	Start generator	Minimum load	0%	100%	5%

1.17.12.4 Stop gen-set

This set-point is used to stop the gen-set. When the imported mains power decreases below the set-point, the stop sequence of the gen-set is commenced. The set-point in channel 3041 refers to the mains power set-points in channel 3011 or 3012.

No.	Setting		Min. setting	Max. setting	Factory setting
3040	Stop generator	Selection display	-	-	-
3041	Stop generator	Set-point	20%	80%	60%
3042	Stop generator	Timer	0.0 s	990.0 s	30.0 s

1.17.12.5 Test running

No.	Setting		Min. setting	Max. setting	Factory setting
3070	Test	Selection display	-	-	-
3071	Test	Set-point	1%	100%	80%
3072	Test	Timer	0.0 s	990.0 s	300.0 s

Channel 3072 is only available on the master gen-set if option G4 is selected.

1.17.12.6 Test sequence

When the TEST mode is selected, the gen-set is automatically started and synchronised with the mains. The sequence of the TEST is as follows:

- START sequence starts the gen-set
- Synchronise the generator breaker to the busbar (mains)
- Gen-set is loaded to the setting in channel 3071
- The parallel time expires and the generator is deloaded
- GB opens
- STOP sequence stops the gen-set

The test mode is activated by selecting TEST with the “MODE” pushbutton on the display. The TEST mode can be used in peak shaving and AMF mode. After the test run the AGC returns to AUTO operation.

1.17.12.7 Fixed power set-point (set-point for active generator power and power factor)

The fixed power set-points are used when the AGC is configured to fixed power operation. The PF (power factor) set-point is used when the generator is running parallel to mains.

No.	Setting		Min. setting	Max. setting	Factory setting
3080	Fixed power set-point	Selection display	-	-	-
3081	Fixed power set-point	P set-point	0%	100%	100%
3082	Fixed power set-point	PF set-point	0.60	1.00	0.90

1.17.12.8 Mains power export

The mains power export reference points are used according to the day- and nighttime adjustments in the menu 3020. The day- and nighttime settings in the menus 3091/3092 are not actual set-points but reference points.

The mains power SET-POINT is the REFERENCE POINT (3091/3092) * START GEN MPE.

Example:

Daytime reference point = 750 kW
Start Gen MPE = 40%
Gen-set set-point: 750*40/100 = 300 kW

Refer to the drawing of the mains power export, page 72.

The transducer scale must be configured according to the 4..20 mA range:

- 4 mA = Transducer scale Tmin
- 20 mA = Transducer scale Tmax

No.	Setting		Min. setting	Max. setting	Factory setting
3090	Mains power export	Selection display	-	-	-
3091	Mains power export	Day	-20000 kW	0 kW	-750 kW
3092	Mains power export	Night	-20000 kW	0 kW	-1000 kW
3093	Mains power export	Transducer scale Tmax	0 kW	20000 kW	1500 kW
3094	Mains power export	Transducer scale Tmin	-20000	0	-1500

1.17.12.9 Start generator (mains power export)

When running in auto mode the gen-set will start when the exported load decreases the “start gen MPE” set-point (3101) when the time delay (3102) expires.

The minimum load set-point (menu 3103) is used when the gen-set is paralleling to another generator and this generator (e.g. a windmill) is exporting the load equal to or higher than the mains power export set-point (menu 3091/3092).

No.	Setting		Min. setting	Max. setting	Factory setting
3100	Start gen MPE	Selection display	-	-	-
3101	Start gen MPE	Set-point	0%	100%	40%
3102	Start gen MPE	Timer	0.0 s	990.0 s	10.0 s
3103	Start gen MPE	Minimum load	0%	100%	5%

1.17.12.10 Stop generator (mains power export)

The generator will stop when the exported power increases the “stop gen MPE” set-point.

No.	Setting		Min. setting	Max. setting	Factory setting
3110	Stop gen MPE	Selection display	-	-	-
3111	Stop gen MPE	Set-point	5%	100%	60%
3112	Stop gen MPE	Timer	0.0 s	990.0 s	10.0 s

1.17.13 System setup

In the system setup it is possible to set up the AGC with the specific parameters for application, engine and generator.

***** R0 (none): Refer to chapter 1.17 for max. relay setting.

1.17.13.1 Nominal settings

No.	Setting		Min. setting	Max. setting	Factory setting
4010	Nominal settings	Selection display	-	-	-
4011	Nominal settings	Frequency	48.0 Hz	62.0 Hz	60.0 Hz
4012	Nominal settings	Generator power	10 kW	20000 kW	480 kW
4013	Nominal settings	Generator current	0 A	9000 A	787 A
4014	Nominal settings	Generator volt.	100 V	25000 V	440 V

1.17.13.2 Transformer generator (voltage transformer for generator voltage measuring)

Voltage transformer: If no voltage transformer is present, the primary and secondary side values are set to generator nominal value.

No.	Setting		Min. setting	Max. setting	Factory setting
4020	Transformer gen.	Selection display	-	-	-
4021	Transformer gen.	Volt. prim.	100 V	25000 V	440 V
4022	Transformer gen.	Volt. sec.	100 V	690 V	440 V
4023	Transformer gen.	Current prim.	5 A	9000 A	1000 A
4024	Transformer gen.	Current sec.	1 A	5 A	5 A

1.17.13.3 Transformer busbar (voltage transformer for busbar voltage measuring)

Voltage transformer: If no voltage transformer is present, the primary and secondary side values are set to generator nominal value.

No.	Setting		Min. setting	Max. setting	Factory setting
4030	Transformer bus.	Selection display	-	-	-
4031	Transformer bus.	Volt. prim.	100 V	25000 V	440 V
4032	Transformer bus.	Volt. sec.	100 V	690 V	440 V

1.17.13.4 Communication control enable/disable control (option H)

No.	Setting		Min. setting	Max. setting	Factory setting
4040	Communication control	Selection display	-	-	-
4041	Communication control	Power	OFF	ON	OFF
4042	Communication control	Frequency	OFF	ON	OFF
4043	Communication control	Voltage	OFF	ON	OFF
4044	Communication control	PF	OFF	ON	OFF

NOTE:
Selecting communication control ON will overrule external and internal settings.

1.17.13.5 External communication control (option H)

No.	Setting		Min. setting	Max. setting	Factory setting
4050	Ext. communication ID	Selection display	-	-	-
4051	Ext. communication ID	ID	1	247	3
4052	Ext. communication ID	Baud rate	9600	19200	9600

The Baud rate can only be changed with Modbus communication.
The Baud rate is automatically changed with Profibus communication.

1.17.13.6 External communication control (option H)

No.	Setting		Min. setting	Max. setting	Factory setting
4060	Ext. communication error	Selection display	-	-	-
4061	Ext. communication error	Timer	1.0 s	100.0 s	10.0 s
4062	Ext. communication error	Relay output A	R0 (none)	R0 (none) *	R0 (none)
4063	Ext. communication error	Relay output B	R0 (none)	R0 (none) *	R0 (none)
4064	Ext. communication error	Enable	OFF	ON	OFF

1.17.13.7 Internal communication control (option G4-G5)

The ID number must be selected on each individual AGC. (Default ID = 1). ID #1 is defined as the master unit. In channel 4070 on each individual slave AGC the correct ID number must be selected. The ID numbers must be different on each AGC. When an ID number different from 1 on each slave AGC is selected, the communication is automatically activated. This can be seen in channel 4080.

No.	Setting		Min. setting	Max. setting	Factory setting
4070	Int. communication ID	Selection display	-	-	-
4071	Int. communication ID	ID	1	2	1

1.17.14 Enable ID

If an AGC unit for some reason is disconnected, a “CAN ID x missing” alarm will occur. To deactivate the alarm it is necessary to disable the ID number (channel 4080) in all the other enabled AGCs. When the disconnected unit is put back into operation it is automatically enabled.

No.	Setting		Min. setting	Max. setting	Factory setting
4080	Enable ID	Selection display	-	-	-
4081	Enable ID 1	Enable	OFF	ON	OFF
4082	Enable ID 2	Enable	OFF	ON	OFF

1.17.14.1 Date and time (internal clock) setting

The date and time can easily be synchronised with the present time and date from the utility software.

No.	Setting		Min. setting	Max. setting	Factory setting
4100	Date and time	Selection display	-	-	-
4101	Date and time	Year	2001	2100	Depends on the software version
4102	Date and time	Month	1	12	
4103	Date and time	Date	1	31	
4104	Date and time	Hour	0	23	
4105	Date and time	Minute	0	59	

1.17.14.2 Measuring of generator running time and circuit breaker operations

The function “Running time” counts the hours the generator has been running (voltage on generator present).
The function “GB operations” counts how many times the generator breaker has been closed.
The function “MB operations” counts how many times the mains breaker has been closed.
The function “Reset kWh counter” resets the amount of produced kWh.

The counters can be reset/set.

No.	Setting		Min. setting	Max. setting	Factory setting
4120	Counters	Selection display	-	-	-
4121	Running time	Running time	0	20000	0
4122	GB operations	GB operations	0	20000	0
4123	MB operations	MB operations	0	20000	0
4124	Reset kWh counter	kWh	OFF	ON	OFF

1.17.14.3 Service timer

The function of the service timer enables the user to get an alarm when service of the gen-set is needed. The timer is reset when the alarm is acknowledged or when the timer is disabled and enabled again.

No.	Setting		Min. setting	Max. setting	Factory setting
4130	Service timer	Selection display	-	-	-
4131	Service timer	Set-point	0 h	9000 h	500 h
4132	Service timer	Relay output A	0	10	0
4133	Service timer	Relay output B	0	10	0
4134	Service timer	Enable	OFF	ON	ON

1.17.14.4 Battery undervoltage alarm

No.	Setting		Min. setting	Max. setting	Factory setting
4220	Battery low V	Selection display	-	-	-
4221	Battery low V	Set-point	15.0 V	24.0 V	18.0 V
4222	Battery low V	Timer	0.0 s	10.0 s	1.0 s
4223	Battery low V	Relay output A	R0 (none)	R0 (none) *	R0 (none)
4224	Battery low V	Relay output B	R0 (none)	R0 (none) *	R0 (none)
4225	Battery low V	Enable	OFF	ON	ON

The alarm is for the auxiliary power supply. To avoid damage of the multi-line 2 AGC it is necessary to use a 1 A fuse if the voltage is able to fall below 15 VDC.

1.17.14.5 Language

No.	Setting		Setting	Factory setting
4230	Language	Selection display	-	-
4231	Language	English	English	English
		Deutsch	Deutsch	-
		Français	Français	-
		Español	Español	-

1.17.14.6 Loadshare output

This function enables the user to set the voltage level of the active power loadshare line. This is only possible if the loadshare type Pow-R-Con is chosen (channel 4250).

No.	Setting		Min. setting	Max. setting	Factory setting
4240	Loadshare out	Selection display	-	-	-
4241	Loadshare out	Loadshare out	1.0 V	5.0	5.0 V

Only visible if Pow-R-Con in 4251 is selected.

1.17.14.7 Loadshare type

This function enables the user to set the type of active power loadshare.

No.	Setting		Type 1	Type 2	Type 3	Factory setting
4250	L. share type	Selection display	-	-	-	-
4251	L. share type	L. share type	DEIF	Selco T4800	Pow-R-Con	DEIF

1.17.14.8 Engine type

No.	Setting		First setting	Second setting	Factory setting
4300	Engine type	Selection display	-	-	-
4301	Engine type	Engine type	Diesel engine	Gas engine	Diesel engine

1.17.14.9 Running mode

No.	Setting		First setting	Second setting	Factory setting
4310	Running mode	Selection display	-	-	-
4311	Running mode	Running mode	Single gen-set	Multi gen-set	Single gen-set

The functionality of the multi-line 2 AGC is depending on the running mode setup.

1.17.14.10 Gen-set modes

5 gen-set modes are available:

No.	Setting		Setting	Factory setting
4320	Gen-set mode	Selection display	-	-
4321	Gen-set mode	Island operation	Island operation	-
	Gen-set mode	AMF	AMF	AMF
	Gen-set mode	Peak shaving	Peak shaving	-
	Gen-set mode	Fixed power	Fixed power	-
	Gen-set mode	Load take over	Load take over	-

1.17.14.10.1 Island mode

The gen-set is running in island mode. The multi-line 2 AGC is controlling the gen-set and the generator breaker in the system. The multi-line 2 AGC does not control the mains breaker if any is installed. The control functionality of the multi-line 2 AGC is start up of the engine, closing/synchronising and loading of the gen-set. It is only possible to operate the gen-set in “SEMI-AUTO” mode.

1.17.14.10.2 AMF – automatic mains failure gen-set

The multi-line 2 AGC is controlling the gen-set and both the generator and the mains breaker. The control functionality of the multi-line 2 AGC is automatic start up of the engine at a mains failure and subsequent opening of the mains breaker and closing of the generator breaker. The multi-line 2 AGC automatically back synchronises the generator to mains when the mains is restored after a predefined time if back synchronising is enabled. If back synchronising is disabled, the AGC opens the GB and closes the MB when the mains is OK.

1.17.14.10.3 Peak shaving operation

The multi-line 2 AGC is controlling the gen-set and both the generator and the mains breaker. The control functionality of the multi-line 2 AGC is automatic start up of the gen-set and subsequent synchronising when the imported load from mains is exceeding the start gen-set set-point. The multi-line 2 AGC deloads and stops the gen-set at the stop gen-set set-point.

In “SEMI-AUTO” mode the gen-set follows the peak shaving load curve but it does not start/stop when the start/stop limit is reached. The two breakers (MB and GB) will not react automatically but only by using the two breaker pushbuttons.

Using the peak shaving mode it is possible to select between two different peak shaving sequences by using menu 4430 “MB control”.

- Mode shift off
- Peak – AMF – peak

The first sequence (mode shift off) is a mode which only reacts on the peak shaving sequence. If a mains failure occurs, the MB will open and the gen-set will cool down and stop.

The second sequence (peak – AMF – peak) is a mode which reacts on the peak shaving sequence but also reacts as AMF mode if a mains failure occurs. The normal operation is peak shaving. At a mains failure it changes to AMF operation and finally it returns to peak shaving operation when the mains supply is restored.

1.17.14.10.4 Mains power export, MPE

The multi-line 2 AGC is controlling the gen-set and both the generator and the mains breaker. The control functionality is start up of the gen-set and subsequent synchronising and closing of the generator breaker.

In the mains power export mode the AGC requires a binary start command to start up the gen-set.

The mains power export can be used in two situations:

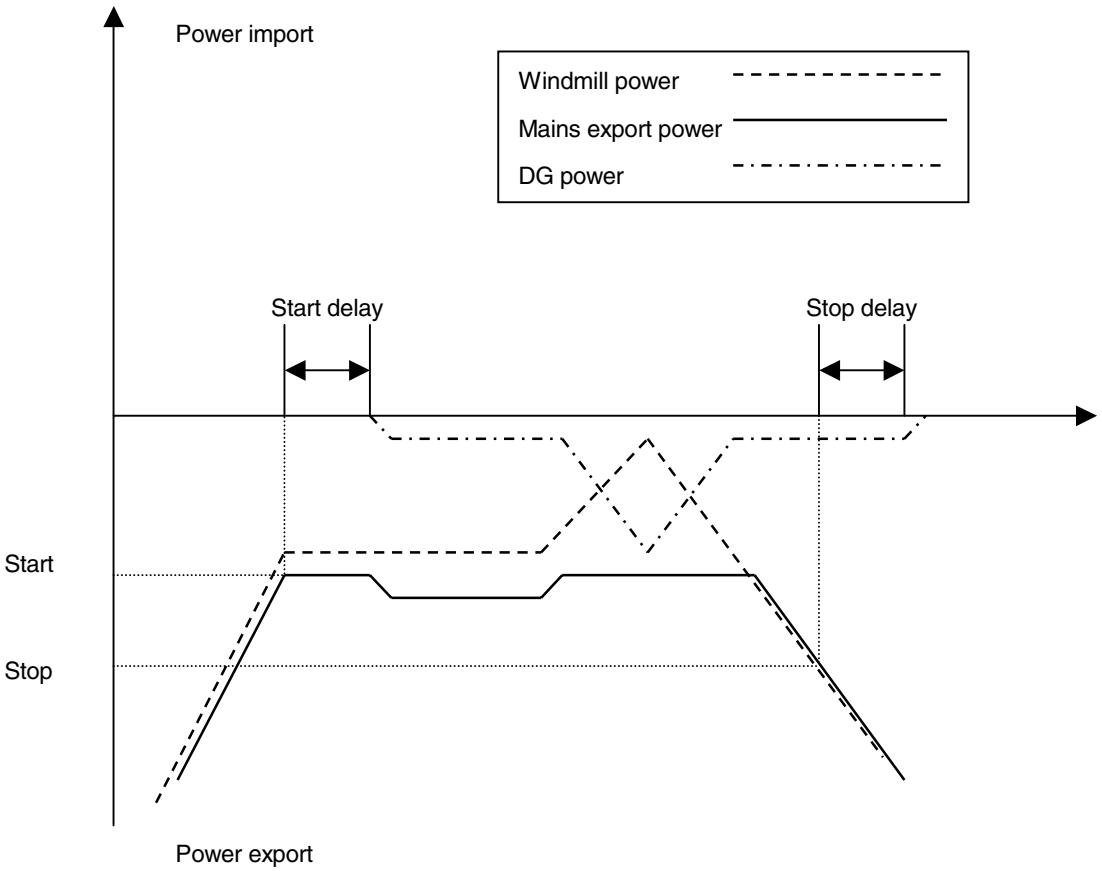
Single gen-set:
Requires a binary start command to start. The mains power export set-point will be the reference point (3091/3092) multiplied with the start up percentage (3101).

	Reference point	**Start up percentage**	**AGC mains power export set-point**
Menu numbers	3091	3101	-
Settings	1000 kW	40%	**1000*40/100 = 400 kW**

Multiple gen-set:
This could e.g. be when paralleling to a windmill. Then the AGC will control its gen-set according to the total exported power.

The mains power export set-point of the AGC will be the reference point (3091/3092) multiplied with the start up percentage (3101).

	Reference point	**Start up percentage**	**AGC mains power export set-point**
Menu numbers	3091	3101	-
Settings	1000 kW	40%	**1000*40/100 = 400 kW**



NOTE:
In the drawing above the graphics for the mains export power and the windmill power are displaced a little when the mains power export decreases, until the gen-set starts and when the mains power export increases. This is for illustrative reasons.

1.17.14.10.5 Fixed power operation

Both the mains and the generator breaker can be controlled through the multi-line 2 AGC. The control functionality is semi-auto start up of the gen-set and subsequent synchronising and ramp up to the fixed power set-point in channel 3081. The var is controlled according to the PF set-point (3082).

1.17.14.10.6 Load take over mode

Both the mains and the generator breaker can be controlled through the multi-line 2 AGC. When the load take over mode is selected, it must be activated through a binary input. The gen-set will start, synchronise and take the necessary load until the mains import is 0 kW. Then the mains breaker will be opened, and the generator will supply the load. When the load take over sequence is stopped (binary input), the load will be transferred to the mains supply.

NOTE:
A 4…20 mA transducer is needed as an indication of the actual mains load.

The load take over mode can be combined with the short time paralleling function (menu 4940).

1.17.15 multi-line 2 AGC sequences

This chapter contains information about the sequences of the engine, the generator breaker and, if installed, the mains breaker. These sequences are executed if the AUTO mode is selected and if the commands are selected in SEMI-AUTO mode. In SEMI-AUTO the sequence selected is the only sequence which is executed. (E.g. press the START pushbutton: The engine is started with no subsequent synchronising).

The following sequences are described:

- START sequence
- GB ON sequence
- GB OFF sequence
- MB ON sequence
- MB OFF sequence
- STOP sequence

Breaker sequences - the multi-line 2 AGC is able to control the breakers in the system:

- AMF: Generator and mains breaker
- Peak shaving: Generator and mains breaker
- Island mode: Generator breaker (no mains breaker installed)
- Fixed power: Generator and mains breaker

If island operation is selected, it is necessary to make a short circuit on terminal 24 (mains breaker open). A “Mains breaker failure” will occur if the connection is not made.

1.17.15.1 Start sequence

The multi-line 2 AGC is controlling the start sequence of the engine according to the drawing and the set-points below.

No.	Setting		Min. setting	Max. setting	Factory setting
4350	Remove starter	Selection display	-	-	-
4351	Remove starter	Set-point	1 RPM	4000 RPM	400 RPM
4352	Remove starter	Number of teeth	0 teeth	500 teeth	0 teeth

The “remove starter” set-point is used to deactivate the start relay. The number of teeth is used to configure the tacho input. This function can also be used with a digital input.

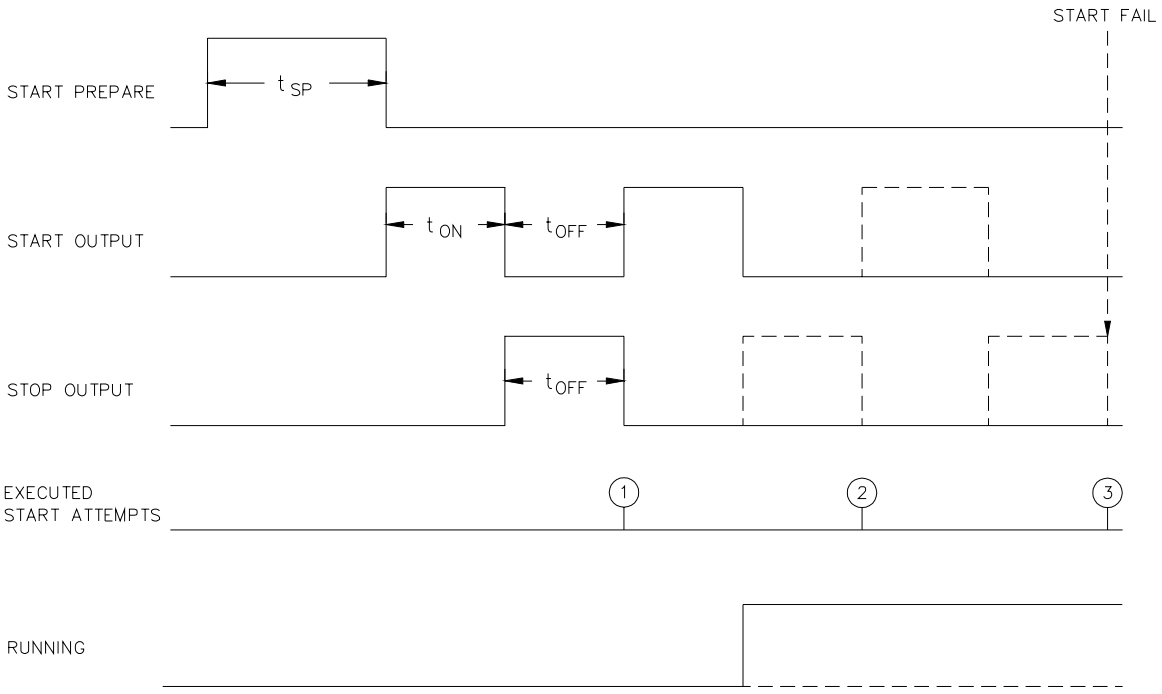
The tacho input must be configured to 0 teeth when not in use.

No.	Setting		Min. setting	Max. setting	Factory setting
4360	Starter	Selection display	-	-	-
4361	Starter	Start prepare	0.0 s	600.0 s	5.0 s
4362	Starter	Start ON time	1.0 s	30.0 s	5.0 s
4363	Starter	Start OFF time	1.0 s	99.0 s	5.0 s

The settings “start prepare”, “start ON time” and “start OFF time” are the periods the relays on the engine interface card slot #7 are activated.

The start prepare output can e.g. be used for prelubricating or preheating. The start relay output is for activating the starter of the engine. The start sequence can be activated manually by pressing the “START” pushbutton in SEMI-AUTO.

No.	Setting		Min. setting	Max. setting	Factory setting
4370	Start attempts	Selection display	-	-	-
4371	Start attempts	Attempts	1	10	3
4372	Start attempts	Relay output A	R0 (none)	R0 (none) *	R0 (none)
4373	Start attempts	Relay output B	R0 (none)	R0 (none) *	R0 (none)



The automatic start sequence - here programmed to max. 3 start attempts, but the engine starts during the second attempt.

Interruption of start sequence:

- Running feedback (deactivates the start relay)
  - Channel 4351, tacho configuration set-point
  - Running feedback input
  - Internal measuring of the frequency above 30Hz
    NOTE: The frequency measurement requires a voltage measurement of at least 30%. So the running feedback based on the frequency measurement can only be used where the voltage builds up rapidly.
- Stop signal
- Start failure

If the gen-set does not start after the last start attempt, a start failure alarm is activated. The start sequence can be stopped manually by pressing the “STOP” pushbutton if SEMI-AUTO mode is selected.

1.17.15.2 GB ON sequence

The GB ON sequence will synchronise and/or close the generator breaker. The breaker is closed directly without synchronising if the mains breaker is open or if no mains breaker is present (island mode), if the voltage on the busbar/mains is not present.

The GB ON sequence is automatically initiated (except in SEMI-AUTO mode) when the automatic start sequence has been completed and the engine is running.

In SEMI-AUTO mode the operator may initiate the GB ON sequence by pressing the "GB" pushbutton on the display.

Ready for GB ON:
Conditions which must be fulfilled before a GB ON signal is activated:

- Running feedback from the engine
- The frequency and voltage has been present in the time “f/U OK” (channel 4381)

This will initiate synchronising and/or closing of the generator breaker.

No.	Setting		Min. setting	Max. setting	Factory setting
4380	f/U OK	Selection display	-	-	-
4381	f/U OK	Timer	1.0 s	99.0 s	5.0 s

Timer function is described in chapter 1.10.4.

No.	Setting		Min. setting	Max. setting	Factory setting
4390	f/U failure	Selection display	-	-	-
4391	f/U failure	Timer	1.0 s	99.0 s	30.0 s
4392	f/U failure	Relay output A	R0 (none)	R0 (none) *	R0 (none)
4393	f/U failure	Relay output B	R0 (none)	R0 (none) *	R0 (none)

Interruption of the GB ON sequence:

- Synchronisation alarm
- GB ON alarm
- GB pushbutton pressed in SEMI-AUTO
- f/U failure

1.17.15.3 GB OFF sequence

The GB OFF sequence is automatically initiated (except in SEMI-AUTO mode) when the generator has to be stopped. In AMF operation this is when the mains returns and the mains breaker is synchronised, and in PEAK SHAVING operation this is when the load is to be supplied by the mains only.

In SEMI-AUTO mode the operator may initiate the GB OFF sequence by pressing the "GB" pushbutton on the display.

Sequence: **(if parallel with mains)**
- De-load the generator
- Open the breaker at a configurable set-point (channel 2122)

Sequence: **(if island mode)**
- Open the breaker instantly

Interruption of the GB OFF sequence:

- A DELOAD alarm
- A GB OFF alarm
- GB pushbutton is pressed in SEMI-AUTO mode

1.17.15.4 MB ON sequence

The MB ON sequence will synchronise and/or close the mains breaker.

In AUTO mode the MB ON sequence is automatically initiated if the multi-line 2 AGC is in AMF operation and the mains returns after a mains failure. In peak shaving mode the MB ON sequence is automatically initiated when the mains is OK.

If the generator breaker is open and the mains is present the MB will be closed immediately in AUTO mode.

In SEMI-AUTO mode the operator may initiate the MB ON sequence by pressing the "MB" pushbutton on the display. Pressing the MB pushbutton in SEMI-AUTO will close the MB immediately, if the GB is open and the mains is present.

Ready for MB ON:
Conditions that must be fulfilled before a MB ON signal is activated:

- No active MB alarms
- Mains OK

This will initiate synchronising and/or closing of the mains breaker.

Interruption of the MB ON sequence:

- Mains failure alarm
- MB ON alarm
- MB OFF pushbutton in SEMI-AUTO

1.17.15.5 MB OFF sequence

The MB OFF sequence is automatically initiated (except in SEMI-AUTO mode). In SEMI-AUTO mode the operator may initiate the MB OFF sequence by pressing the "MB" pushbutton on the display.

Sequence: AUTO **(mains failure)**
- Mains not present
- Open the mains breaker

Sequence: SEMI-AUTO **(gen-set parallel with mains)**
- MB pushbutton is pressed
- Open the mains breaker

Sequence: SEMI-AUTO **(gen-set stopped, the mains supplies the load)**
- MB OFF pushbutton pressed
- Open the mains breaker

Interruption of the MB OFF sequence:

- MB OFF alarm
- Pressing the MB pushbutton in SEMI-AUTO operation

1.17.15.6 Stop sequence

Stop sequence:

- Programmable cooling down time
- "STOP" output with programmable extended stop time

The stop sequence is carried out when the multi-line 2 AGC has completed the GB OFF sequence and the generator breaker is open. In AUTO mode the stop sequence is initiated automatically. In SEMI-AUTO mode a stop command with the "STOP" pushbutton will stop the engine without cooling down. If the generator is running with the generator breaker closed and the “STOP” pushbutton is pressed, the generator is opened without deloading, and the engine is stopped without cooling down.
A start command will interrupt an ongoing cool down period and leave the engine in idle speed. A GB ON signal will synchronise and close the breaker.

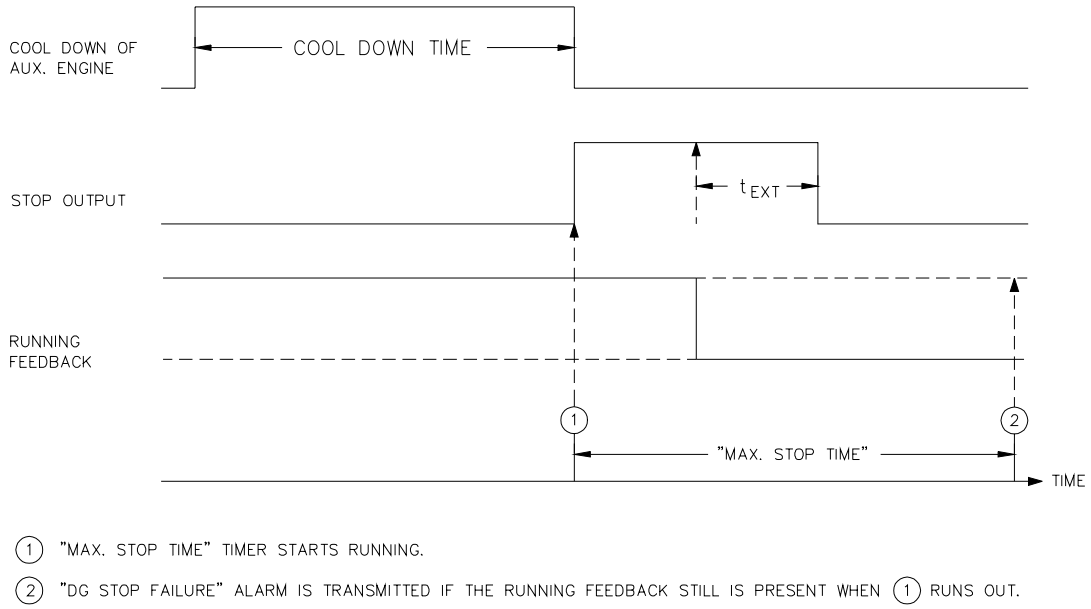
A stop failure is displayed if the running feedback signal or the generator voltage and frequency are still present.

If the coil type is configured as “running coil”, the stop relay will be energized during starting and running and de-energized during stopping.

STOP parameters

No.	Setting		Min. setting	Max. setting	Factory setting
4400	Stop	Selection display	-	-	-
4401	Stop	Cool down time	0.0 s	999.0 s	240.0 s
4402	Stop	Extended STOP	1.0 s	99.0 s	5.0 s
4403	Stop	Coil type	STOP	RUN	STOP

No.	Setting		Min. setting	Max. setting	Factory setting
4410	Stop failure	Selection display	-	-	-
4411	Stop failure	Timer	10.0 s	120.0 s	30.0 s
4412	Stop failure	Relay output A	R0 (none)	R0 (none) *	R0 (none)
4413	Stop failure	Relay output B	R0 (none)	R0 (none) *	R0 (none)



(1) "MAX. STOP TIME" TIMER STARTS RUNNING.

(2) "DG STOP FAILURE" ALARM IS TRANSMITTED IF THE RUNNING FEEDBACK STILL IS PRESENT WHEN (1) RUNS OUT.

The automatic stop sequence.

1.17.15.7 Mains failure

Automatic mains failure is detected when the multi-line 2 AGC is in AUTO mode and configured as an AMF unit. When the timer "FAIL DELAY" expires the following sequence is carried out:

- MB is opened
- Start sequence is initiated
- GB is closed

In case of MB open fail the sequence is stopped and an "MB OPEN FAILURE" alarm is displayed.

When the mains returns, the change over sequence is started. The sequence is started when the timer "MAINS OK DELAY" expires:

- MB is synchronised
- GB is de-loaded (if parallel running is allowed – channel 4425)
- GB is opened
- Stop sequence is initiated

In case of a sequence alarm the sequence will be stopped. If GB OFF fail and parallel running is not allowed, the MB is opened.

No.	Setting		Min. setting	Max. setting	Factory setting
4420	Mains failure	Selection display	-	-	-
4421	Mains failure	Fail. delay	1.0 s	990.0 s	5.0 s
4422	Mains failure	Mains OK delay	10.0 s	990.0 s	60.0 s
4423	Mains failure	Low voltage	80%	100%	97%
4424	Mains failure	High voltage	100%	120%	103%
4425	Mains failure	Mains fail. control	Start eng. + open MB	Start eng.	Start eng. + open MB

1.17.16 Mains breaker

No.	Setting		Min. setting	Max. setting	Factory setting
4430	MB control	Selection display	-	-	-
4431	MB control	Function	Mode shift OFF	Mode shift ON	Mode shift OFF
4432	MB control	Timer t_{MBC}	0.0 s	30.0 s	0.5 s
4433	MB control	Back synchronisation	OFF	ON	OFF

For description of mode shift in combination with the peak shaving operation, please refer to chapter 1.17.14.10.

All modes can handle the mode shift function. The mode shift will be active when the unit is in auto. The function is that the AGC automatically goes into Automatic Mains Failure mode at a mains failure situation. The AGC will start up and supply the load. When

the mains returns, the AGC goes to mains supply (black change over or synchronising) and subsequently returns to the original mode.

1.17.17 Horn timeout

No.	Setting		Min. setting	Max. setting	Factory setting
4440	Alarm horn	Selection display	-	-	-
4441	Alarm horn	Timer	0.0 s	990.0 s	20.0 s

The setting is the maximum time the horn is sounding at an alarm. If the setting is adjusted to 0 s, the horn will sound continuously until the alarm is acknowledged.

1.17.18 Generator breaker

No.	Setting		Min. setting	Max. setting	Factory setting
4450	GB control	Selection display	-	-	-
4451	GB control	Timer t_{GBC}	0.0 s	30.0 s	2.0 s

1.17.19 Analogue output configuration (option F1)

The analogue output options each consist of two independent 0(4)…20 mA outputs. Each of the two outputs can be chosen to represent any of the following values.

1.17.19.1 Power (P kW) output

No.	Setting		Min. setting	Max. setting	Factory setting
4500	Power output	Selection display	-	-	-
4501	Power output	Output A	0	2	0
4502	Power output	Output B	0	2	0
4503	Power output	Type	0-20 mA	4-20 mA	4-20 mA
4504	Power output	Max. value	0 kW	20000 kW	500 kW
4505	Power output	Min. value	-9999 kW	20000 kW	0 kW

1.17.19.2 Apparent power (S kVA) output

No.	Setting		Min. setting	Max. setting	Factory setting
4510	S output	Selection display	-	-	-
4511	S output	Output A	0	2	0
4512	S output	Output B	0	2	0
4513	S output	Type	0-20 mA	4-20 mA	4-20 mA
4514	S output	Max. value	0 kVA	20000 kVA	600 kVA
4515	S output	Min. value	-9999 kVA	20000 kVA	0 kVA

1.17.19.3 Reactive power (Q kvar) output

No.	Setting		Min. setting	Max. setting	Factory setting
4520	React. power output	Selection display	-	-	-
4521	React. power output	Output A	0	2	0
4522	React. power output	Output B	0	2	0
4523	React. power output	Type	0-20 mA	4-20 mA	4-20 mA
4524	React. power output	Max. value	0 kvar	16000 kvar	400 kvar
4525	React. power output	Min. value	-8000 kvar	16000 kvar	0 kvar

1.17.19.4 Power factor (PF) output

No.	Setting		Min. setting	Max. setting	Factory setting
4530	Power factor output	Selection display	-	-	-
4531	Power factor output	Output A	0	2	0
4532	Power factor output	Output B	0	2	0
4533	Power factor output	Type	0-20 mA	4-20 mA	4-20 mA
4534	Power factor output	Max. value	0.5	1.0	0.8
4535	Power factor output	Min. value	-0.5	1.0	-0.8

1.17.19.5 Frequency output

No.	Setting		Min. setting	Max. setting	Factory setting
4540	Frequency output	Selection display	-	-	-
4541	Frequency output	Output A	0	2	0
4542	Frequency output	Output B	0	2	0
4543	Frequency output	Type	0-20 mA	4-20 mA	4-20 mA
4544	Frequency output	Max. value	0 Hz	70 Hz	55 Hz
4545	Frequency output	Min. value	0 Hz	70 Hz	45 Hz

1.17.19.6 Voltage output

The voltage output represents the L1-L2 voltage.

No.	Setting		Min. setting	Max. setting	Factory setting
4550	Voltage output	Selection display	-	-	-
4551	Voltage output	Output A	0	2	0
4552	Voltage output	Output B	0	2	0
4553	Voltage output	Type	0-20 mA	4-20 mA	4-20 mA
4554	Voltage output	Max. value	0 V	28000 V	500 V
4555	Voltage output	Min. value	0 V	28000 V	0 V

1.17.19.7 Current output

The current output represents the L1 current.

No.	Setting		Min. setting	Max. setting	Factory setting
4560	Current output	Selection display	-	-	-
4561	Current output	Output A	0	2	0
4562	Current output	Output B	0	2	0
4563	Current output	Type	0-20 mA	4-20 mA	4-20 mA
4564	Current output	Max. value	0 A	9000 A	1000 A
4565	Current output	Min. value	0 A	9000 A	0 A

1.17.19.8 Relay setup

The relays can be configured in the two different ways described below.

Alarm relay function: When an alarm activates the relay, it is activated as long as the alarm is present and unacknowledged.

Limit function: When an alarm activates the relay, no alarm message is displayed. After the condition activating this relay has returned to normal, the relay will deactivate when the “Off delay” has expired.

The relays 1-4 are available if option M14 is selected.

No.	Setting		First/min. setting	Second/max. setting	Factory setting
4610	Relay 1	Selection display	-	-	-
4611	Relay 1	Function	Alarm	Limit	Alarm
4612	Relay 1	Off delay	0.0 s	999.9 s	5.0 s

No.	Setting		First/min. setting	Second/max. setting	Factory setting
4620	Relay 2	Selection display	-	-	-
4621	Relay 2	Function	Alarm	Limit	Alarm
4622	Relay 2	Off delay	0.0 s	999.9 s	5.0 s

No.	Setting		First/min. setting	Second/max. setting	Factory setting
4630	Relay 3	Selection display	-	-	-
4631	Relay 3	Function	Alarm	Limit	Alarm
4632	Relay 3	Off delay	0.0 s	999.9 s	5.0 s

No.	Setting		First/min. setting	Second/max. setting	Factory setting
4640	Relay 4	Selection display	-	-	-
4641	Relay 4	Function	Alarm	Limit	Alarm
4642	Relay 4	Off delay	0.0 s	999.9 s	5.0 s

The relays 5-8 are available if option M12 is selected.

No.	Setting		First/min. setting	Second/max. setting	Factory setting
4650	Relay 5	Selection display	-	-	-
4651	Relay 5	Function	Alarm	Limit	Alarm
4652	Relay 5	Off delay	0.0 s	999.9 s	5.0 s

No.	Setting		First/min. setting	Second/max. setting	Factory setting
4660	Relay 6	Selection display	-	-	-
4661	Relay 6	Function	Alarm	Limit	Alarm
4662	Relay 6	Off delay	0.0 s	999.9 s	5.0 s

No.	Setting		First/min. setting	Second/max. setting	Factory setting
4670	Relay 7	Selection display	-	-	-
4671	Relay 7	Function	Alarm	Limit	Alarm
4672	Relay 7	Off delay	0.0 s	999.9 s	5.0 s

No.	Setting		First/min. setting	Second/max. setting	Factory setting
4680	Relay 8	Selection display	-	-	-
4681	Relay 8	Function	Alarm	Limit	Limit
4682	Relay 8	Off delay	0.0 s	999.9 s	5.0 s

The relays 9-10 are available if options D1 and D2 are not selected and analogue governor outputs are not used.

No.	Setting		First/min. setting	Second/max. setting	Factory setting
4690	Relay 9	Selection display	-	-	-
4691	Relay 9	Function	Alarm	Limit	Limit
4692	Relay 9	Off delay	0.0 s	999.9 s	5.0 s

No.	Setting		First/min. setting	Second/max. setting	Factory setting
4700	Relay 10	Selection display	-	-	-
4701	Relay 10	Function	Alarm	Limit	Limit
4702	Relay 10	Off delay	0.0 s	999.9 s	5.0 s

1.17.19.9 Caterpillar® CCM setup (option H4)

No.	Setting		Min. setting	Max. setting	Factory setting
4760	CCM control	Selection display	-	-	-
4761	CCM control	CCM Baud rate	9600	19200	19200
4762	CCM control	CCM version	M5X version 0	M5X version #1	M5X version #1

No.	Setting		Min. setting	Max. setting	Factory setting
4770	List 1 setup	Selection display	-	-	-
4771	List 1 setup	MID/UNIT number	21$	61$	24$
4772	List 1 setup	Enable list	OFF	ON	OFF
4773	List 1 setup	Update rate	0.5 s	127.0 s	2.0 s

The setup of the lists is done in the same way as list 1, channel 4770. The following lists are available:

Channel number	List number
4770	List 1 setup
4780	List 2 setup
4790	List 3 setup
4800	List 4 setup
4810	List 5 setup
4820	List 6 setup
4830	List 7 setup
4840	List 8 setup
4850	List 9 setup
4860	List 10 setup
4870	List 11 setup
4880	List 12 setup
4890	List 13 setup
4900	List 14 setup
4910	List 15 setup
4920	List 16 setup

1.17.20 Short time paralleling

No.	Setting		Min. setting	Max. setting	Factory setting
4940	Max. parallel time	Setting	-	-	-
4941	Max. parallel time	Enable	ON	OFF	OFF
4942	Max. parallel time	Time	0.1 s	990.0 s	0.3 s

The short time paralleling can be used in the load take over mode and the AMF mode. Be aware that the test function will still parallel to the mains, no matter the adjustment of the above setting.

1.17.21 User password

The user password menu can only be entered using the “JUMP” pushbutton.

No.	Setting		Min. setting	Max. setting	Factory setting
4976	User password	Setting	0	32000	2000

1.17.22 Service menu

The service menu can only be entered using the “JUMP” pushbutton. This menu is used in service situations.

In the alarm selection you can see all the alarm timers and their remaining time if they are counting.

The input and output selections show the present status of the inputs and outputs. E.g. mode inputs, relay outputs and load sharing lines.

No.	Setting		Description
4980	Service menu	Selection display	
4981	Service menu	Alarm	Shows remaining alarm delay time
4982	Service menu	Digital input	Shows digital input status
4983	Service menu	Digital output	Shows digital output status

1.18 General data

1.18.1 Technical specifications

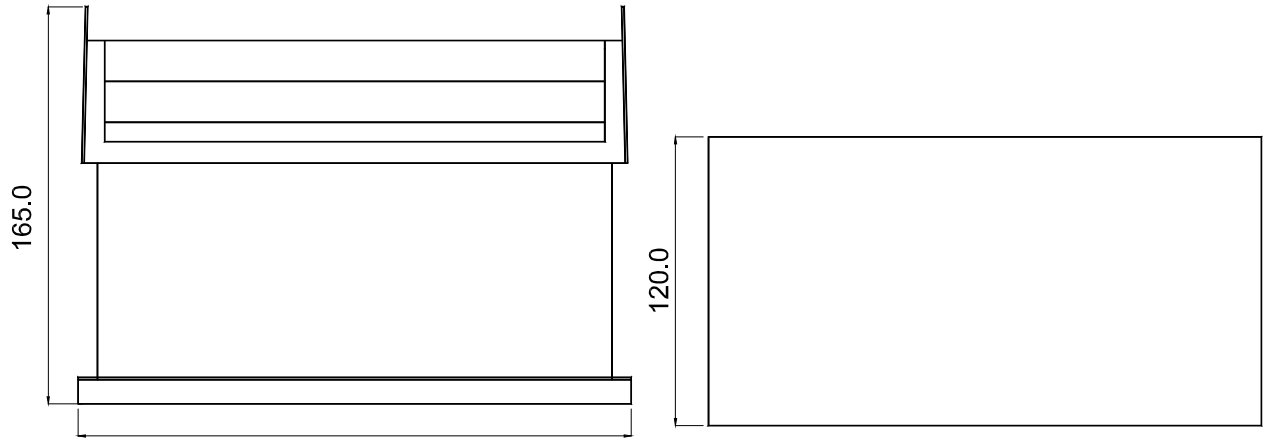
Accuracy:	Class 1.0 according to IEC 688
Operating temperature:	-25…70°C
Aux. supply:	24 VDC -25/+30%
Measuring voltage:	100…690 VAC. Consumption max. 0.15 VA per phase
Frequency:	30…70 Hz
Measuring current:	From current transformers …/1 A or …/5 A. Consumption max. 0.3 VA per phase
Binary inputs:	Input voltage 12…32 VDC. Impedance 2.4 kΩ, bi-directional
Open collector outputs:	Supply voltage 12…32 VDC. Load max. 10 mA
Load sharing lines:	+/-5 VDC
Analogue inputs:	+/-10 VDC, impedance 100 kΩ (not galvanically separated) 0(4)…20 mA, impedance 50 Ω (not galvanically separated)
Relay outputs:	250 V/8 A or 24 VDC/1 A. Refer to actual description of I/Os
Safety:	To EN 61010-1 installation category (overvoltage category) III, 600 V, pollution degree 2
Galvanic separation:	Between AC voltage, AC current and other I/Os: 3250 VAC – 50 Hz – 1 min. Between analogue outputs: 500 VDC – 1 min.
EMC/CE:	According to EN-50081-1/2, EN-50082-1/2, SS4361503 (PL4) and IEC 255-3
Material:	All plastic parts are self-extinguishing to UL94 (V1)
Climate:	HSE, to DIN 40040
Connections:	4 mm^2 multi stranded for AC currents, all others 2.5 mm^2 multi stranded
Response times:	From the set-point is reached till the output is activated and the delay set to 0.

Busbar 2:	Over-/undervoltage	<50 ms
	Over-/underfrequency	<50 ms
Generator and busbar 1:	Over-/undervoltage	70-200 ms
	Over-/underfrequency	70-200 ms
Current:		100-200 ms
Fast overcurrent:		<42 ms
High overcurrent:		100-200 ms
Rocof:		100 ms (4 periods)
Vector jump:		30 ms

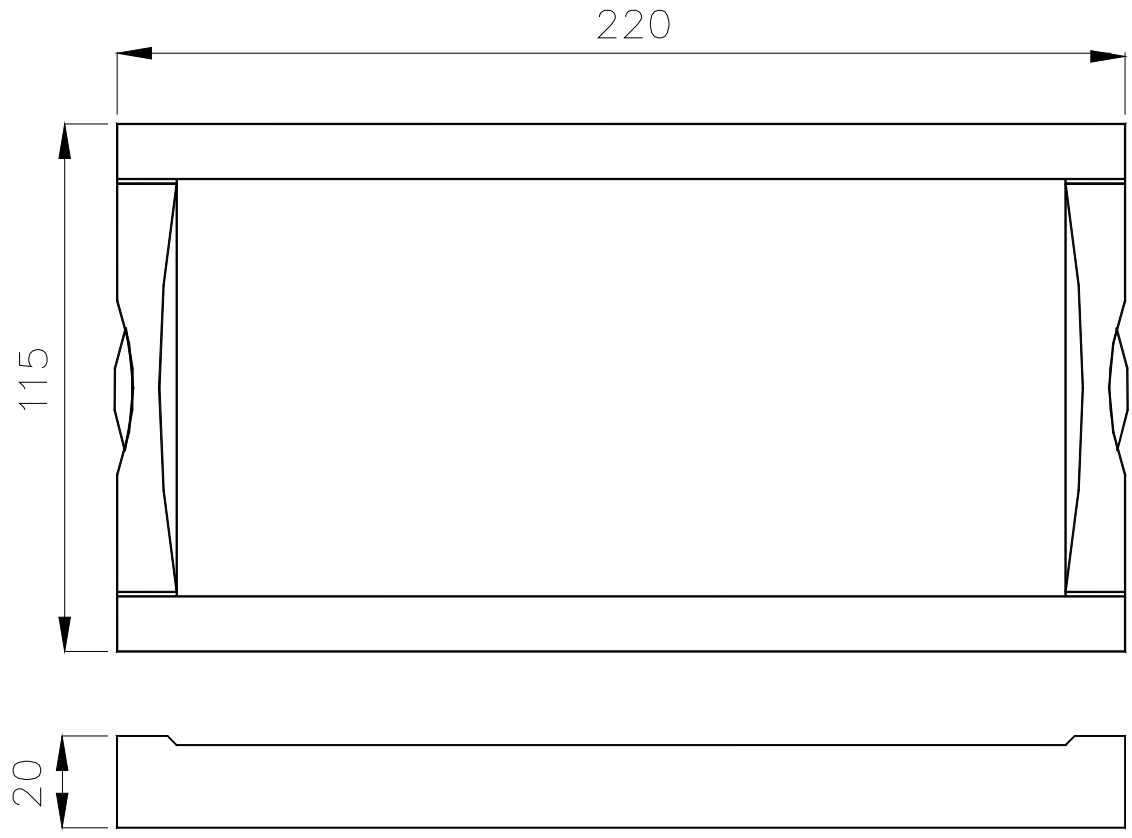
Protection:
Case: IP40
Terminals: IP20
Operator panel: IP52 (IP54 when mounted with gasket)
To IEC 529 and EN 60529

Mounting: Base mounted with six screws or DIN-rail mounted.

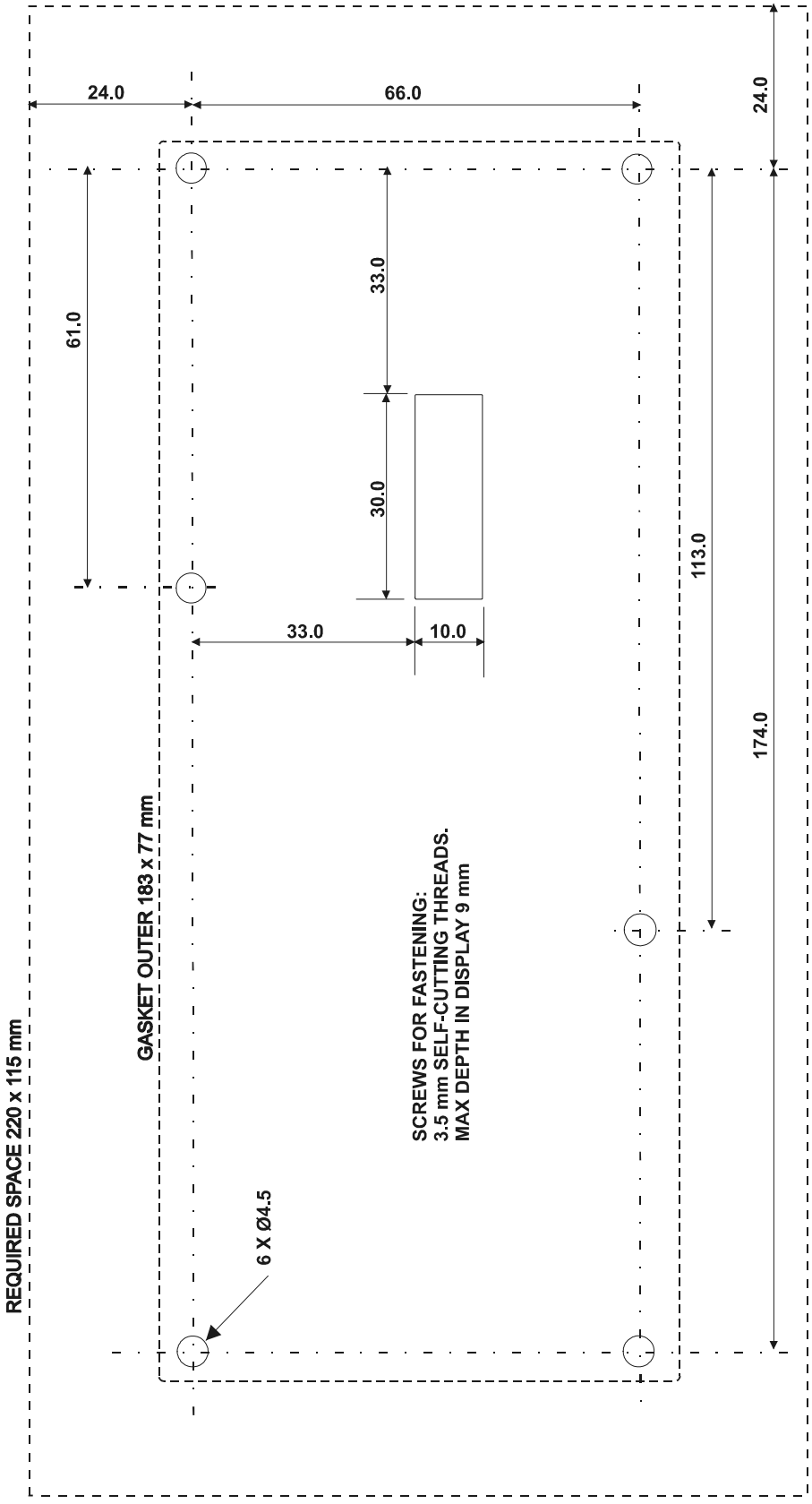
1.19 Unit dimensions



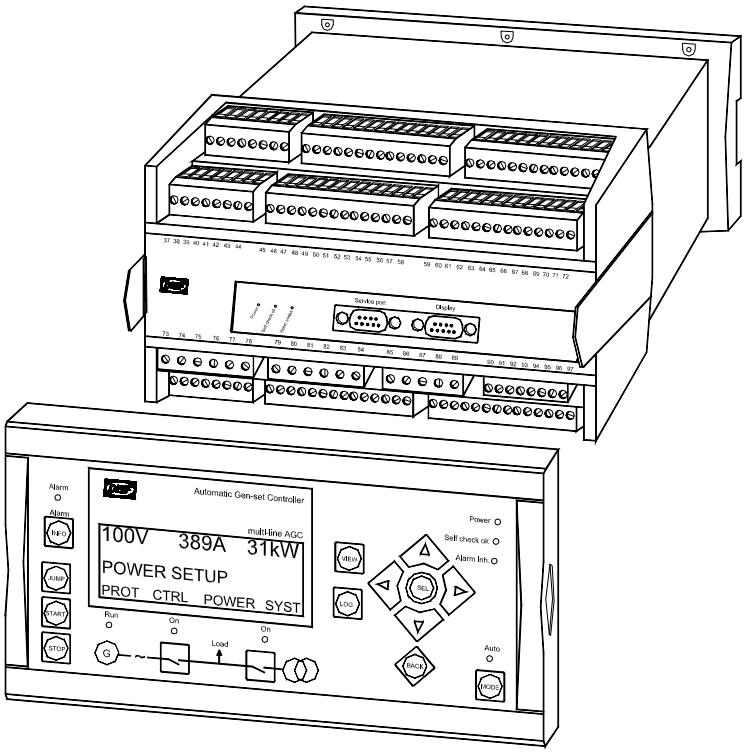
1.20 Display dimensions



1.21 Panel cutout for display



2 Modbus protocol



- *RS-485: Modbus RTU*

2.1 General information

2.1.1 General introduction to multi-line 2 Modbus

Each message must be transmitted in a continuous stream. Only the RTU mode can be used on multi-line 2 communication. Broadcast function is not implemented in multi-line 2 and is therefore not allowed.

Error check field

- Cyclical Redundancy Check (CRC)

multi-line 2 RS-485 hardware settings

- 9600 or 19200 bps
- 8 data bits
- None parity
- 1 stop bit

2.1.2 Transactions on multi-line 2 Modbus Protocol

Standard Modbus ports on multi-line 2 use an RS-485 compatible serial interface that defines connector pinouts, cabling, signal levels, transmission baud rates.
Controllers communicate using a master-slave technique in which only one device (the master) can initiate transactions (called "queries"). The other devices (the slaves) respond by supplying the requested data to the master or by taking the action requested in the query.

The Modbus Protocol establishes the format for the master's query by placing into it the device address, a function code defining the requested action, any data to be sent and an error checking field. The slave's response message is also constructed using Modbus Protocol. It contains fields confirming the action taken, any data to be returned and an error checking field. If an error occurred on receipt of the message, an exception response is generated in the slave.

2.1.3 The query-response cycle

Query
Device address
Function
Eight-bit data byte
Error check (CRC)

Response
Device address
Function
Eight-bit data byte
Error check (CRC)

The query
The function code in the query tells the addressed slave device what kind of action to perform. The data bytes contain any additional information that the slave will need to perform the function. For example, function code 03 will query the slave to read registers and respond with their contents. The data field must contain the information telling the slave which register to start at and how many registers to read. The error check field provides a method for the slave to validate the integrity of the message contents.

The response
If the slave makes a normal response, the function code in the response is an echo of the function code in the query. The data bytes contain the data collected by the slave, such as register values or status. If an error occurs, the function code is modified to indicate that the response is an error response and the data bytes contain a code that describes the error. The error check field allows the master to confirm that the message contents are valid.

2.1.4 RTU framing

In RTU mode messages start with a silent interval of at least 3.5 character times. This is most easily implemented as a multiple of character times at the baud rate that is being used on the network (shown as T1-T2-T3-T4 in the table below).
The first field then transmitted is the device address.
The allowable characters transmitted for all fields are hexadecimal 0-9, A-F.
Networked devices monitor the network bus continuously, including during the "silent" intervals. When the first field (the address field) is received, each device decodes it to find out if it is the addressed device.
Following the last transmitted character, a similar interval of at least 3.5 character times marks the end of the message. A new message can begin after this interval.
The entire message frame must be transmitted as a continuous stream. If a silent interval of more than 1.5 character times occurs

before completion of the frame, the receiving device flushes the incomplete message and assumes that the next byte will be the address field of a new message.
Similarly, if a new message begins earlier than 3.5 character times following a previous message, the receiving device will consider it a continuation of the previous message. This will set an error, as the value in the final CRC field will not be valid for the combined messages. A typical message frame is shown below.

Start	Address	Function	Data	CRC check	End
T1-T2-T3-T4	8 bits	8 bits	N x 8 bits	16 bits	T1-T2-T3-T4

2.1.5 How the address field is handled

The address field of a message frame contains eight bits. Valid slave device addresses are in the range of 1-247 decimal.
A master addresses a slave by placing the slave address in the address field of the message. When the slave sends its response, it places its own address in the address field of the response to let the master know which slave is responding.
Address 0 is used for the broadcast address.
Broadcasts are not allowed.

2.1.6 Contents of the error checking field

The RTU mode error checking field contains a 16 bit value implemented as two eight bit bytes. The error check value is the result of Cyclical Redundancy Check calculation performed on the message contents. The CRC field is appended to the message as the last field in the message. When this is done, the low-order byte of the field is appended first, followed by the high-order byte. The CRC high-order byte is the last byte to be sent in the message.
Additional information about error checking follows later in this chapter.

2.1.7 How characters are transmitted serially

When messages are transmitted on standard Modbus serial networks, each character or byte is sent in this order (left to right):

Least Significant Bit (LSB) ... Most Significant Bit (MSB).

With RTU character framing, the bit sequence is:
Without parity checking.

Start	1	2	3	4	5	6	7	8	Stop

NOTE: No even or odd parity checking is supported.

2.1.8 Error checking methods

In RTU mode messages include an error checking field that is based on a Cyclical Redundancy Check (CRC) method. The CRC field checks the contents of the entire message. The CRC field is two bytes, containing a 16 bit binary value. The CRC value is calculated by the transmitting device which appends the CRC to the message.
The receiving device recalculates a CRC during receipt of the message and compares the calculated value to the actual value it received in the CRC field. If the two values are not equal, an error results.
Only the eight bits of data in each character are used for generating the CRC. Start and stop bits do not apply to the CRC.
When the CRC is appended to the message, the low-order byte is appended first, followed by the high-order byte. The master is configured by the user to wait for a predetermined time-out interval before aborting the transaction. This interval is set to be long enough for any slave to respond normally. If the slave detects a transmission error, the message will not be acted upon. The slave will not construct a response to the master. Thus the time-out will expire and allow the master's program to handle the error.
Note that a message addressed to a non-existent slave device will also cause a time-out.

2.2 Functions

2.2.1 Function 01(01hex) read flag status

Reads the ON/OFF status of discrete flags in the slave.

Address area for reading of status flags

multi-line 2 Data to request	multi-line 2 Table	Address area
Status	Status table	0-499
Alarm active	Parameter table	500-999
Alarm acknowledge	Parameter table	1000-1499
Digital input	Digital input table	1500-1599
Digital output	Digital output table	2000-2499
Timer output	Parameter table	2500-2999
Timer running	Parameter table	3000-3499
Enable	Parameter table	3500-3999

*) The max. number of data query is limited of the length of the actual table.

The query message specifies the starting flag and quantity of flags to be read. Example of a query to read 10...22 from multi-line 2 slave device 4:

Index	Field name	Example
0	Slave address	04h
1	Function	01h
2	Starting address Hi	00h
3	Starting address Lo	0Ah
4	Number of flags Hi	00h
5	Number of flags Lo	0Dh
6	Error check (CRC) Lo	DDh
7	Error check (CRC) Hi	98h

Response

The flag status response message is packed as one flag per bit of the data field. Status is indicated as: 1 is the value ON, and 0 is the value OFF. The LSB of the first data byte contains the flag addressed in the query. The other flags follow toward the high-order end of this byte and from low order to high order in subsequent bytes. If the returned flag quantity is not a multiple of eight, the remaining bits in the final data byte will be padded with zeroes (toward the high-order end of the byte). The byte count field specifies the quantity of complete bytes of data.

Example of a response to the query:

Index	Field name	Example
0	Slave address	04h
1	Function	01h
2	Byte count	02h
3	Data (flags 17...10)	0Ah
4	Data (flags 27...20)	11h
8	Error check (CRC) Lo	B3h
9	Error check (CRC) Hi	50h

The status of flags 17...10 is shown as the byte value 0A hex or binary 00001010. Flag 17 is the MSB of this byte, and flag 10 is the LSB. Left to right, the status of flags 17...10 is:
OFF-OFF-OFF-OFF-ON-OFF-ON-OFF.

2.2.2 Function 03(03hex) read registers

Reads the binary of registers in the slave.

Address area for reading of registers

multi-line 2 Data to request	multi-line 2 Table	Address area
Measuring values	Measuring values table	0-499
Timers used	Parameter table	500-999
Timers minimum	Parameter table	1000-1499
Timers maximum	Parameter table	1500-1599
Values used	Parameter table	2000-2499
Values minimum	Parameter table	2500-2999
Values maximum	Parameter table	3000-3499
Output a	Parameter table	5000-5499
Output b	Parameter table	9000-9499

*) The max. number of data query is limited of the length of the actual table or max. 100.

Query

The query message specifies the starting register and quantity of registers to be read. Example of a request to read 0...1 from multi-line 2 slave device 1:

Index	Field name	Example
0	Slave address	01h
1	Function	03h
2	Starting address Hi	00h
3	Starting address Lo	00h
4	Number of registers Hi	00h
5	Number of registers Lo	02h
6	Error check (CRC) Lo	C4h
7	Error check (CRC) Hi	0Bh

Response

The register data in the response message are packed as two bytes per register, with the binary contents right justified within each byte. For each register the first byte contains the high-order bits, and the second contains the low-order bits.

Example of a response to the query:

Index	Field name	Example
0	Slave address	01h
1	Function	03h
2	Byte count	04h
3	Data Hi	00h
4	Data Lo	06h
5	Data Hi	00h
6	Data Lo	05h
7	Error check (CRC) Lo	DAh
8	Error check (CRC) Hi	31h

The contents of register 0 are shown as the two byte values of 00 06 hex. The contents of register 1 are 00 05 hex.

2.2.3 Function 15(0Fhex) write multiple flags

Writes each flag (0 x reference) in a sequence of flags to either ON or OFF.

Address area for writing of status flags

multi-line 2 Data to request	multi-line 2 Table	Address area
Commands	Command table	0-499
Alarm acknowledge	Parameter table	1000-1499
Enable	Parameter table	3500-3999

*) The max. number of data query is limited of the length of the actual table.

Query

The query message specifies the flag references to be forced.

The requested ON/OFF status is specified by contents of the query data field. A logical 1 in a bit position of the field requests the corresponding flag to be ON - A logical = requests it to be OFF. The following page shows an example of a request to force a series of ten flags stating a flag in slave device 1. The query data contents are two bytes: 01 04 hex (1001 0000 binary). The binary bits correspond to the flags in the following way:

Bit: 0 1 1 0 0 0 0 0 1 0 0 1 0 0 0 0

Flag: 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0

The first byte transmitted (0 hex) addresses flags 7...0, with the least significant bit addressing the lowest flag (0) in this set.

The next byte transmitted (01 hex) addresses flags 14 and 8, with the least significant bit addressing the lowest flag (8) in the set. Unused bits in the last data byte should be zero-filled.

Example for multi-line 2 slave device 1:

Index	Field name	Example
0	Slave address	01h
1	Function	0Fh
2	Flag address Hi	01h
3	Flag address Lo	00h
4	Number of flags Hi	00h
5	Number of flags Lo	0Fh
6	Byte count	02h
7	Force data (7...0)	90h
8	Force data (14...8)	60h
9	Error check (CRC) Lo	99h
10	Error check (CRC) Hi	1Ch

Response

The normal response returns the slave address, function code, starting address and quantity of flags forced. Here is an example of a response to the query shown above.

Index	Field name	Example
0	Slave address	01h
1	Function	0Fh
2	Flag address Hi	01h
3	Flag address Lo	00h
4	Number of flags Hi	00h
5	Number of flags Lo	0Fh
6	Error check (CRC) Lo	14h
7	Error check (CRC) Hi	33h

2.2.4 Function 16(10hex) write register

Writes values into a sequence of registers.

Address area for writing of registers

multi-line 2 Data to request	multi-line 2 Table	Address area
Control	Control table	0-499
Timers used	Parameter table	500-999
Values used	Parameter table	2000-2499
Relay A used	Parameter table	5000-5499
Relay B used	Parameter table	9000-9499

*) The max. number of data query is limited of the length of the actual table and max. 100.

Example of a request to preset two registers starting at timer no to 00 60 and 00 70 hex, in slave multi-line 2 device 1:

Index	Field name	Example
0	Slave address	01h
1	Function	10h
2	Starting address Hi	01h
3	Starting address Lo	28h
4	Number of registers Hi	00h
5	Number of registers Lo	02h
6	Byte count	04h
7	Data Hi	00h
8	Data Lo	60h
9	Data Hi	00h
10	Data Lo	70h
11	Error check (CRC) Lo	FCh
12	Error check (CRC) Hi	7Bh

Response

The normal response returns the slave address. Function code, starting address and quantity of registers preset.

Example of a response to the query shown above:

Index	Field name	Example
0	Slave address	01h
1	Function	10h
2	Starting address Hi	01h
3	Starting address Lo	28h
4	Number of registers Hi	00h
5	Number of registers Lo	02h
6	Error check (CRC) Lo	C0h
7	Error check (CRC) Hi	3Ch

2.3 Exception

2.3.1 Exception reception

When a master device sends a query to a slave device, it expects a normal response. One of four possible events can occur from the master's query:

If the slave device receives the query without a communication error and can handle the query normally, it returns a normal response.

If the slave does not receive the query due to a communication error, no response is returned. The master program will eventually process a time-out condition for the query.

If the slave receives the query, but detects a communication error (CRC), no response is returned. The master program will eventually process a time-out condition for the query.

If the slave receives the query without a communication error, but cannot handle it (for example if the request is to read a non-existent register), the slave will return an exception response informing the master of the nature of the error.

The exception response message has two fields that differentiate it from a normal response:

Function code field: In a normal response the slave echoes the function code of the original query in the function code field of the response. All function codes have a most-significant bit (MSB) of 0. This makes the function code value in an exception response exactly 80 hexadecimal higher than the value would be for a normal response.
With the function code's MSB set, the master's application program can recognize the exception response and can examine the data field for the exception code.

Data field: In a normal response the slave may return data or statistics in the data field (any information that was requested in the query). In an exception response the slave returns an exception code in the data field. This defines the slave condition that caused the exception.

Example of a master query and slave exception response:

Query

Index	Field name	Example
0	Slave address	01h
1	Function	03h
2	Starting address Hi	07h
3	Starting address Lo	03h
4	Number of registers Hi	00h
5	Number of registers Lo	02h
6	Error check (CRC) Lo	C0h
7	Error check (CRC) Hi	3Ch

Response

Index	Field name	Example
0	Slave address	01h
1	Function	83h
2	Exception code	02h
7	Error check (CRC) Lo	C0h
8	Error check (CRC) Hi	F1h

The master addresses a query to slave device 01h. The function code (03) is for a *Read Registers*, it requests the status of the register at an address which is out of range.

2.3.2 Exception codes

Code	Field name	Meaning
01h	Illegal function	The function code received in the query is not an allowable action for the slave
02h	Illegal data address	The data address received in the query is not an allowable address for the slave
03h	Illegal data value	A value contained in the query data fields is not an allowable value for the slave

2.4 Data tables

2.4.1 Measurement table (read only) (function code 03h)

Address	Content	Type
0		Application version
1	U_{L1-L2}	Generator voltage. Measured in [V]
2	U_{L2-L3}	Generator voltage. Measured in [V]
3	U_{L3-L1}	Generator voltage. Measured in [V]
4	U_{L1-N}	Generator voltage. Measured in [V]
5	U_{L2-N}	Generator voltage. Measured in [V]
6	U_{L3-N}	Generator voltage. Measured in [V]
7	F_{GEN}	Generator frequency. Measured in [Hz/100]
8	I_{L1}	Generator current. Measured in [A]
9	I_{L2}	Generator current. Measured in [A]
10	I_{L3}	Generator current. Measured in [A]
11	Cos-phi	-99...0...100 Generator cosinus-phi. Measured in cos-phi:100 Negative value means capacitive cos-phi
12	P_{GEN}	Generator active power. Measured in [W]. Negative value means reverse power
13	Q_{GEN}	Generator reactive power. Measured in [var]. Positive value means generated inductive reactive power
14	$U_{BBL1-L2}$	Busbar. Measured in [V]
15	F_{BB}	Busbar frequency L1. Measured in [Hz/100]
16 [HI]	Exp. U_{GEN}	Exponent generator voltage
16 [LO]	Exp. I_{GEN}	Exponent generator current
17 [HI]	Exp. P/Q_{GEN}	Exponent generator power/reactive power
17 [LO]	Exp. U_{BB}	Exponent busbar voltage
18 [HI] 19 [LO]	E_{GEN}	Energy counter. Measured in [kWh]. Max. 300000MWh
20	Alarms	Bit 0 1010. U-BB High step 1 Bit 1 1020. U-BB High step 2 Bit 2 1030. U-BB Low step 1 Bit 3 1040. U-BB Low step 2 Bit 4 1050. f-BB High step 1 Bit 5 1060. f-BB High step 2 Bit 6 1070. f-BB Low step 1 Bit 7 1080. f-BB Low step 2 Bit 8 1090. Reverse power Bit 9 1100. High current step 1 Bit 10 1110. High current step 2 Bit 11 1120. High power step 1 Bit 12 1130. High power step 2 Bit 13 1220. Unbalance current Bit 14 1230. Unbalance voltage
21	Alarms	Bit 0 1240. Q import Bit 1 1250. Q export Bit 2 1260. df/dt Bit 3 1270. Vector jump Bit 4 2060. GB sync. fail. Bit 5 4220. Supply alarm Bit 6 GB close fail. Bit 7 GB open fail. Bit 8 GB position feedback fail. Bit 9 Phase sequence error Bit 10 2070. MB sync. fail. Bit 11 MB close fail. Bit 12 MB open fail.

Address	Content	Type	
		Bit 13	MB position feedback fail.
		Bit 14	4390. Generator voltage/frequency fail.
		Bit 15	Tacho fail.
22	Alarms	Bit 0	1310. U-DG High step 1
		Bit 1	1320. U-DG High step 2
		Bit 2	1330. U-DG Low step 1
		Bit 3	1340. U-DG Low step 2
		Bit 4	1350. f-DG High step 1
		Bit 5	1360. f-DG High step 2
		Bit 6	1370. f-DG Low step 1
		Bit 7	1380. f-DG Low step 2
		Bit 8	1520. Fast overcurr.
		Bit 9	1530. High overcurr.
		Bit 13	4370. Start fail.
		Bit 14	Ramp down fail.
		Bit 15	4410. Stop fail.
23	Alarms engine interface	Bit 0	1400. 4-20mA in No. 1
		Bit 1	1410. 4-20mA in No. 2
		Bit 2	1420. 4-20mA in No. 3
		Bit 3	1430. 4-20mA in No. 4
		Bit 4	1440. PT100 No. 1
		Bit 5	1450. PT100 No. 2
		Bit 6	1460. Tacho
		Bit 9	1490. Dig. input No. 8
		Bit 10	1500. Dig. input No. 9
		Bit 11	1510. Dig. input No. 10
24	Alarms analogue input and digital input	Bit 0	1800. 4-20mA in No. 5
		Bit 1	1810. 4-20mA in No. 6
		Bit 2	1820. 4-20mA in No. 7
		Bit 3	1830. 4-20mA in No. 8
		Bit 4	1600. Dig. input No. 11
		Bit 5	1610. Dig. input No. 12
		Bit 6	1620. Dig. input No. 13
		Bit 7	1630. Dig. input No. 14
		Bit 8	1640. Dig. input No. 15
		Bit 9	1650. Dig. input No. 16
		Bit 10	1660. Dig. input No. 17
25	Alarms load share	Bit 0	1670. Dig. input No. 18
		Bit 1	1680. Dig. input No. 19
		Bit 2	1690. Dig. input No. 20
		Bit 3	1700. Dig. input No. 21
		Bit 4	1710. Dig. input No. 22
		Bit 5	1720. Dig. input No. 23
		Bit 6	1730. Dig. input No. 24
		Bit 7	1740. Dig. input No. 25
		Bit 8	1750. Dig. input No. 26
		Bit 9	1760. Dig. input No. 27
		Bit 10	1770. Dig. input No. 28
		Bit 11	1780. Dig. input No. 29
		Bit 12	1790. Dig. input No. 30
26	Status	Bit 0	GB pos. on
		Bit 1	MB pos. on
		Bit 2	Alarm inhibit
		Bit 3	Running
		Bit 4	DG voltage/frequency OK
		Bit 5	Mains failure
		Bit 6	Auto mode
		Bit 7	Semi-auto mode
		Bit 8	Test mode
		Bit 9	Reserved (off mode)
		Bit 10	Island mode (gen-set mode ch. 4320)
		Bit 11	AMF mode (gen-set mode ch. 4320)
		Bit 12	Peak shaving mode (gen-set mode ch. 4320)
		Bit 13	Fixed power mode (gen-set mode ch. 4320)

Address	Content	Type
27		Number of alarms
28		Number of unacknowledged alarms
29	U_{DG-max}	Generator max. voltage. Measured in [V]
30	U_{DG-min}	Generator min. voltage. Measured in [V]
31	$U_{BBL2-L3}$	Busbar voltage. Measured in [V]
32	$U_{BBL3-L1}$	Busbar voltage. Measured in [V]
33	U_{BB-max}	Busbar max. voltage. Measured in [V]
34	U_{BB-min}	Busbar min. voltage. Measured in [V]
35	U_{BBL1-N}	Busbar voltage. Measured in [V]
36	U_{BBL2-N}	Busbar voltage. Measured in [V]
37	U_{BBL3-N}	Busbar voltage. Measured in [V]
38		Analog input engine interface No. 4 (scaled)
39		RPM
40	S_{GEN}	Generator seeming power. Measured in [VA]
41	PHI_{L1-L2}	0...359 Generator phase angle. Measured in [deg]
42	PHI_{L2-L3}	0...359 Generator phase angle. Measured in [deg]
43	PHI_{L3-L1}	0...359 Generator phase angle. Measured in [deg]
44	$PHI_{BBL3-L1}$	0...359 Busbar phase angle. Measured in [deg]
45	$PHI_{BBL1-DGL1}$	0...359 Busbar/generator phase angle. Measured in [deg]
46	df/dt_{BB-L1}	df/dt [Hz/100/s]
47	U_{SUPPLY}	Supply voltage. Measured in [V/10]
48	PT100	-40 – 250 temperature in deg. (engine interface)
49	PT100	-40 – 250 temperature in deg. (engine interface)
50		Control register table address 0
51		Control register table address 1
52		Control register table address 3
53		Control register table address 4
54		Reserved
55		Analog input engine interface No. 1 (scaled)
56		Analog input engine interface No. 2 (scaled)
57		Analog input engine interface No. 3 (scaled)
58		Analog input option M15 No. 5 (scaled)
59		Analog input option M15 No. 6 (scaled)
60		Analog input option M15 No. 7 (scaled)
61		Analog input option M15 No. 8 (scaled)
62		Running time
63		Generator breaker operations
64		Mains breaker operations

2.4.2 Control register table (write only) (function code 10h)

Address	Content	Description
0	Power regulator set-point	0...100% of nominal power Activated in menu 4041
1	PF regulator set-point	60...100 stated as PF value/100. The value 100 means PF = 1 Activated in menu 4045
2	Control command	Bit 0 This bit must be 1 when writing the command word If the bit is 0, the control command is don't care Bit 1 Start Bit 2 GB on Bit 3 GB off Bit 4 Stop Bit 5 MB on Bit 6 MB off Bit 7 Bit 8 Bit 9 Bit 10 Alarm ack. Bit 11 Auto Bit 12 Semi Bit 13 Test All bits are automatically reset in the AGC
3	Frequency regulator set-point	-50...50Hz/10. Based on nominal frequency Activated in menu 4042
4	Voltage regulator set-point	-100...100%/10 of nominal voltage Activated in menu 4043
5		

In menu 4040 it is selected, if a set-point is to be controlled by the control registers.
The content of the control registers is not lost in case of supply failure, so frequent updates are not necessary.

Example how to control the frequency via the Modbus:

- Activate frequency control register in menu 4042
- Write in the control register address 3 the desired frequency offset

2.4.3 Command flags table (write only) (function code 0Fh)

Address	Content	Description
0	Start	Start the engine
1	GB on	Close the generator breaker
2	GB off	Open the generator breaker
3	Stop	Stop the engine
4	MB on	Close the mains breaker
5	MB off	Open the mains breaker
6		
7		
8		
9	Alarm ack.	This bit is automatically reset in multi-line 2
10	Auto	
11	Semi	
12	Test	

Same function as address 2 in the control register table.

2.4.4 Status flags table (read only) (function code 01h)

Address	Content	Description
0	GB pos. on	Generator breaker closed
1	MB pos. on	Mains breaker closed
2	Alarm inhibit	
3	Running	
4	DG voltage/frequency OK	Generator voltage and frequency within limits
5	Mains failure	
6	Auto mode	
7	Semi mode	
8	Test mode	
9		

Same content as address 26 in the measurement table.

2.4.5 Parameter table

Offset address	Ch. no.	Content	Unit	Delay	Output a	Output b	Enable
0	-	-	-	-	-	-	-
1	1020	U-BB High step 2	%/10	1/100s	Y	Y	Y
2	1040	U-BB Low step 2	%/10	1/100s	Y	Y	Y
3	1060	f-BB High step 2	%/10	1/100s	Y	Y	Y
4	1080	f-BB Low step 2	%/10	1/100s	Y	Y	Y
5	1260	df/dt (ROCOF)	Hz/10/s	N	Y	Y	Y
6	1270	Vector jump	Deg/10	N	Y	Y	Y
7	1262	df/dt (ROCOF) time	Per	N	N	N	N
8	1010	U-BB High step 1	%/10	1/100s	Y	Y	Y
9	1030	U-BB Low step 1	%/10	1/100s	Y	Y	Y
10	1050	f-BB High step 1	%/10	1/100s	Y	Y	Y
11	1070	f-BB Low step 1	%/10	1/100s	Y	Y	Y
12	1090	Reverse power	%/10	1/10s	Y	Y	Y
13		Reserved					
14	1100	Over current 1	%/10	1/10s	Y	Y	Y
15	1110	Over current 2	%/10	1/10s	Y	Y	Y
16	1160	Over load 1	%/10	1/10s	Y	Y	Y
17	1170	Over load 2	%/10	1/10s	Y	Y	Y
18	1220	Unbalance curr.	%/10	1/10s	Y	Y	Y
19	1230	Unbalance volt.	%/10	1/10s	Y	Y	Y
20	1240	var import	%/10	1/10s	Y	Y	Y
21	1250	var export	%/10	1/10s	Y	Y	Y
22	1310	DG high volt. 1	%/10	1/10s	Y	Y	Y
23	1320	DG high volt. 2	%/10	1/10s	Y	Y	Y
24	1330	DG low volt. 1	%/10	1/10s	Y	Y	Y
25	1340	DG low volt. 2	%/10	1/10s	Y	Y	Y
26	1350	DG high freq. 1	%/10	1/10s	Y	Y	Y
27	1360	DG high freq. 2	%/10	1/10s	Y	Y	Y
28	1370	DG low freq. 1	%/10	1/10s	Y	Y	Y

Offset address	Ch. no.	Content	Unit	Delay	Output a	Output b	Enable
29	1380	DG low freq. 2	%/10	1/10s	Y	Y	Y
30	1520	Fast overcurr.	%/10	1/10s	Y	Y	Y
31	1530	High overcurr.	%/10	1/10s	Y	Y	Y
32	1400	4-20mA in No. 1	User	Y	Y	Y	Y
33	1410	4-20mA in No. 2	User	Y	Y	Y	Y
34	1420	4-20mA in No. 3	User	Y	Y	Y	Y
35	1430	4-20mA in No. 4	User	Y	Y	Y	Y
36	1440	PT100 No. 1	Deg.	Y	Y	Y	Y
37	1450	PT100 No. 2	Deg.	Y	Y	Y	Y
38	1460	Tacho	RPM	Y	Y	Y	Y
39		Reserved					
40		Reserved					
41	1490	Dig. input No. 8	None	Y	Y	Y	Y
42	1500	Dig. input No. 9	None	Y	Y	Y	Y
43	1510	Dig. input No. 10	None	Y	Y	Y	Y
44		Reserved					
45	2011	Static sync.	-	-	-	-	Y
46	2021	Sync. df max.	Hz/10	N	N	N	N
47	2022	Sync. df min.	Hz/10	N	N	N	N
48	2023	Sync. DU max.	%	N	N	N	N
49	2024	Sync. t CB	ms	N	N	N	N
50	2031	GB close t.	1/10s	N	N	N	N
51	2032	Close window	Deg/10	N	N	N	N
52	2033	Phase gain	None	N	N	N	N
53	2034	Freq. gain	None	N	N	N	N
54		Reserved					
55	2051	Blackout df max.	Hz/10	N	N	N	N
56	2052	Blackout dU max.	%	N	N	N	N
57	2053	Blackout enable	n0	N	N	N	Y
58	2060	GB general fail.	n1	1/10s	Y	N	N
59	2070	MB general fail.	None	N	Y	Y	Y
60		Reserved					
61		Reserved					
62	2091	Freq. control DB	%/10	N	N	N	N
63	2092	Freq. control gain	None	N	N	N	N
64	2093	Freq. control time	ms	N	N	N	N
65	2101	Power control DB	%/10	N	N	N	N
66	2102	Power control gain	None	N	N	N	N
67	2103	Power control time	ms	N	N	N	N
68	2111	Power ramp up speed	%/10/s	N	N	N	N
69	2112	Power ramp up point	%	N	N	N	N
70	2121	Power ramp down speed	%/10/s	N	N	N	N
71	2122	Power ramp down point	%	N10	N	N	N
72	2131	P/f control mix factor	None	N	N	N	N
73	2141	Volt. control DB	%/10	N	N	N	N
74	2142	Volt. control gain	None	N	N	N	N
75	2143	Volt. control time	ms	N	N	N	N

Offset address	Ch. no.	Content	Unit	Delay	Output a	Output b	Enable
76	2151	var control DB	%/10	N	N	N	N
77	2152	var control gain	None	N	N	N	N
78	2153	var control time	ms	N	N	N	N
79	2161	Q/U control mix factor	None	N	N	N	N
80	2171	PF control DB	None	N	N	N	N
81	2172	PF control gain	None	N	N	N	N
82	2173	PF control time	ms	N	N	N	N
83	3011	Mains power day	%	N	N	N	N
84	3012	Mains power night	%	N	N	N	N
85	3013	Power converter	kW	N	N	N	N
86	3021	Start hour	None	N	N	N	N
87	3022	Start minute	None	N	N	N	N
88	3023	Stop hour	None	N	N	N	N
89	3024	Stop minute	None	N	N	N	N
90	3031	Start generator	%	Y	N	N	N
91	3032	Base load	%	N	N	N	N
92	3041	Stop generator	%	N	N	N	N
93	3070	Test	%	N	N	N	N
94		Reserved					
95		Reserved					
96		Reserved					
97		Reserved					
98		Reserved					
99		Reserved					
100	4011	Nom. frequency	Hz/10	N	N	N	N
101	4012	Nom. power	kW	N	N	N	N
102	4013	Nom. current	A	N	N	N	N
103	4014	Nom. voltage	V	N	N	N	N
104	4021	Gen. volt. prim.	V	N	N	N	N
105	4022	Gen. volt. sec.	V	N	N	N	N
106	4023	Current prim.	A	N	N	N	N
107	4024	Current sec.	A	N	N	N	N
108	4031	Bus volt. prim.	V	N	N	N	N
109	4032	Bus volt. sec.	V	N	N	N	N
110	4041	Comm. bus control P	n0	N	N	N	Y
111	4042	Comm. bus control f	n0	N	N	N	Y
112	4043	Comm. bus control U	n0	N	N	N	Y
113		Reserved					
114	4045	Comm. bus control P	n0	N	N	N	Y
115	4051	Ext. comm. ID	None	N	N	N	N
116	4052	Baud rate 0=9600, 1=19200	None	N	N	N	N
117	4060	Ext. comm. error	n1	1/10s	Y	Y	Y
118	4071	Control settings P	%	N	N	N	N
119		Reserved					
120	4073	Control settings PF	None	N	N	N	N
121	4220	Battery low V	V/10	1/10s	Y	Y	N
122	4231	Language	n0	N	N	N	Y

Offset address	Ch. no.	Content	Unit	Delay	Output a	Output b	Enable
123		Reserved					
124		Reserved					
125	4300	Engine type	None	N	N	N	N
126	4310	Running mode	None	N	N	N	N
127	4320	Gen-set mode	None	N	N	N	N
128		Reserved	-	-	-	-	-
129		Reserved	-	-	-	-	-
130	4351	Running level	RPM	N	N	N	N
131	4352	Teeth	None	N	N	N	N
132	4361	Start prepare	None	1/10s	N	N	N
133	4362	Start on	None	1/10s	N	N	N
134	4363	Start off	None	1/10s	N	N	N
135	4370	Start attempt/fail.	None	N	Y	Y	N
136		Reserved	-	-	-	-	-
137	4380	Voltage/frequency OK	None	1/10s	N	N	N
138	4390	Voltage/frequency fail.	None	1/10s	Y	Y	N
139	4401	Cool down	None	1/10s	N	N	N
140	4402	Ext. stop time	None	1/10s	N	N	N
141	4403	Stop coil type	None	1/10s	N	N	N
142	4410	Stop fail.	None	1/10s	Y	Y	N
143	4421	Mains failure	None	1/10s	N	N	N
144	4422	Mains OK	None	1/10s	N	N	N
145	4423	Low voltage	%	N	N	N	N
146	4424	High voltage	%	N	N	N	N
147	4425	Back sync.	None	Y	Y	Y	Y
148	4430	Horn time	None	1/10s	N	N	N
149	4502	P output type	0 or 4	N	Y	N	N
150	4512	S output type	0 or 4	N	Y	N	N
151	4522	Q output type	0 or 4	N	Y	N	N
152	4532	PF output type	0 or 4	N	Y	N	N
153	4542	f output type	0 or 4	N	Y	N	N
154	4552	U output type	0 or 4	N	Y	N	N
155	4562	I output type	0 or 4	N	Y	N	N
156	4503	P output max.	kW	N	N	N	N
157	4513	S output max.	kVA	N	N	N	N
158	4523	Q output max.	var	N	N	N	N
159	4533	PF output max.	None	N	N	N	N
160	4543	f output max.	Hz/10	N	N	N	N
161	4553	U output max.	V	N	N	N	N
162	4563	I output max.	A	N	N	N	N
163	4504	P output min.	kW	N	N	N	N
164	4514	S output min.	kVA	N	N	N	N
165	4524	Q output min.	kvar	N	N	N	N
166	4534	PF output min.	None	N	N	N	N
167	4544	f output min.	Hz/10	N	N	N	N
168	4554	U output min.	V	N	N	N	N
169	4564	I output min.	A	N	N	N	N

Offset address	Ch. no.	Content	Unit	Delay	Output a	Output b	Enable
170	4971	Password	None	N	N	N	N
171							
172		GB close error	-	N	GBGF	GBGF	N
173		GB open error	-	N	GBGF	GBGF	N
174		GB position error	-	N	GBGF	GBGF	N
175		MB close error	-	N	MBGF	MBGF	N
176		MB open error	-	N	MBGF	MBGF	N
177		MB position error	-	N	MBGF	MBGF	N
178		Phase sequence error	-	N	GBGF	GBGF	N
179	1800	4-20mA in No. 5	User	Y	Y	Y	Y
180	1810	4-20mA in No. 6	User	Y	Y	Y	Y
181	1820	4-20mA in No. 7	User	Y	Y	Y	Y
182	1830	4-20mA in No. 8	User	Y	Y	Y	Y
183		Reserved	-	-	-	-	-
184		Reserved	-	-	-	-	-
185		Reserved	-	-	-	-	-
186		Reserved	-	-	-	-	-
187	1600	Dig. input No. 11	None	Y	Y	Y	Y
188	1610	Dig. input No. 12	None	Y	Y	Y	Y
189	1620	Dig. input No. 13	None	Y	Y	Y	Y
190	1630	Dig. input No. 14	None	Y	Y	Y	Y
191	1640	Dig. input No. 15	None	Y	Y	Y	Y
192	1650	Dig. input No. 16	None	Y	Y	Y	Y
193	1660	Dig. input No. 17	None	Y	Y	Y	Y
194	1670	Dig. input No. 18	None	Y	Y	Y	Y
195	1680	Dig. input No. 19	None	Y	Y	Y	Y
196	1690	Dig. input No. 20	None	Y	Y	Y	Y
197	1700	Dig. input No. 21	None	Y	Y	Y	Y
198	1710	Dig. input No. 22	None	Y	Y	Y	Y
199	1720	Dig. input No. 23	None	Y	Y	Y	Y
200	1730	Dig. input No. 24	None	Y	Y	Y	Y
201	1740	Dig. input No. 25	None	Y	Y	Y	Y
202	1750	Dig. input No. 26	None	Y	Y	Y	Y
203	1760	Dig. input No. 27	None	Y	Y	Y	Y
204	1770	Dig. input No. 28	None	Y	Y	Y	Y
205	1780	Dig. input No. 29	None	Y	Y	Y	Y
206	1790	Dig. input No. 30	None	Y	Y	Y	Y
207		Relay 0	None	Y	Y	Y	Y
208	4610	Relay 1	None	Y	Y	Y	N
209	4620	Relay 2	None	Y	Y	Y	N
210	4630	Relay 3	None	Y	Y	Y	N
211	4640	Relay 4	None	Y	Y	Y	N
212	4650	Relay 5	None	Y	Y	Y	N
213	4660	Relay 6	None	Y	Y	Y	N
214	4670	Relay 7	None	Y	Y	Y	N
215	4680	Relay 8	None	Y	Y	Y	N
216	4690	Relay 9	None	Y	Y	Y	N

Offset address	Ch. no.	Content	Unit	Delay	Output a	Output b	Enable
217	4700	Relay 10	None	Y	Y	Y	N
218		Reserved	-	-	-	-	-
219		Reserved	-	-	-	-	-
220		Reserved	-	-	-	-	-
221	4431	Mode shift	None	N	N	N	N
222	4124	kWh counter	None	N	N	N	N
223	2190	AVR reg. fail.	%	Y	Y	Y	N
224	2180	GOV reg. fail.	%	Y	Y	Y	N
225		Reserved	-	-	-	-	-
226		Reserved	-	-	-	-	-
227	4070	Int. comm. address	None	N	N	N	N
228		Reserved	-	-	-	-	-
229	4425	Main fail. control	None	N	N	N	N
230	4451	GB on delay	Sec.	Y	N	N	Y
231	4432	MB on delay	Sec.	Y	N	N	Y
232	4081	On Can 1	None	N	N	N	Y
233	4082	On Can 2	None	N	N	N	N
234	4083	On Can 3	None	N	N	N	N
235	4084	On Can 4	None	N	N	N	N
236	4085	On Can 5	None	N	N	N	N
237	4086	On Can 6	None	N	N	N	N
238		Reserved	-	-	-	-	-
239	2201	PWM min.	%	N	N	N	Y
240	2202	PWM value	%	N	N	N	Y
241	2203	PWM max.	%	N	N	N	Y
242	2204	PWM on off	None	N	N	N	Y
243	2211	PWM GOV AVR	None	N	N	N	Y

Refer to the user's manual of your multi-line AGC for information on:

- Availability of channels
- Min./max. settings
- Factory settings

Note that several channels also depend on the options.

However, it is possible to write to channels where the option is not set, it is not possible to enable the channel. E.g. if an attempt is made to write a "1" to the enable flag, the "1" will be discarded, and the enable flag remains "0".
It is not possible to write to offset 0. These values are used for DEIF internal version control.

"y" means that the channel is writeable.
"N" means that a "0" can be written to the channel only.
"N10" means that only the value 10 can be written.
"GBGF" means same output as GB General Failure. 2060.
"MBGF" means same output as MB General Failure. 2070.

Examples:

- Write nominal frequency (4016) 60Hz
  ID = 1, 60Hz = 600Hz/10 = 0258h
  Address 2000 + 80 = 2080d = 0820h
  Tx: 01h 10h 08h 20h 00h 01h 02h 02h 58h 28h 6Ah
  Rx: 01h 10h 08h 20h 00h 01h 02h 63h

- Read nominal frequency (4016) 60Hz
  Tx: 01h 03h 08h 20h 00h 01h 87h A8h
  Rx: 01h 03h 02h 02h 58h B8h DEh
  Read 0258h = 600d

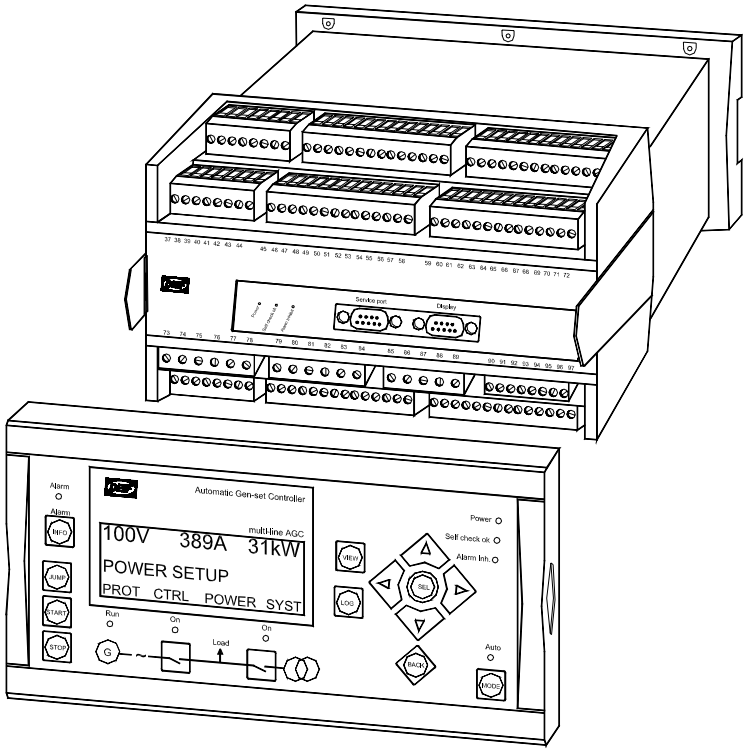
2.4.6 Digital input table (read only 01h)

Address	Terminal	Description
1500	97	Digital input No. 11
1501	96	Digital input No. 12
1502	95	Digital input No. 13
1503	94	Digital input No. 14
1504	93	Digital input No. 15
1505	92	Digital input No. 16
1506	91	Digital input No. 17
1508-27	Reserved	Reserved for digital input PCB 2 - 4
1528	43	Digital input No. 18
1529	44	Digital input No. 19
1530	45	Digital input No. 20
1531	46	Digital input No. 21
1532	47	Digital input No. 22
1533	48	Digital input No. 23
1534	49	Digital input No. 24
1535	50	Digital input No. 25
1536	51	Digital input No. 26
1537	52	Digital input No. 27
1538	53	Digital input No. 28
1539	54	Digital input No. 29
1540	55	Digital input No. 30
1541	23	Alarm inhibit
1542	24	Mains breaker position on
1543	25	Mains breaker position off
1544	26	Generator breaker position on
1545	27	Generator breaker position off
1546-1573	Reserved	
1574	114	Access lock
1575	115	Running
1576	116	Digital input No. 8 engine interface
1577	117	Digital input No. 9 engine interface
1578	118	Digital input No. 10 engine interface

2.4.7 Digital output table (read only 01h)

Address	Terminal	Description
2000	65/66	Governor up
2001	67/68	Governor down
2002	69/70	AVR up
2003	71/72	AVR down
2004 - 2015	Reserved	Reserved for digital output PCB 1 - 4
2016 - 2021	Reserved	
2022	Reserved	
2023	Reserved	
2024	Reserved	
2025	5/6	Horn
2026	8/9	MB off
2027	11/12	MB on
2028	14/15	GB off
2029	17/18	GB on
2030-2043	Reserved	
2044	120/121	Start
2045	122/123	Stop
2046	124/125	Start prepare

3 Profibus protocol



- *Profibus DP*

3.1 General information

3.1.1 General introduction to multi-line 2 PROFIBUS DP

PROFIBUS is a vendor-independent, open field bus standard for a wide range of applications in manufacturing and process automation. Vendor-independence and openness are insured by the international standards EN 50170 and EN 50254.

multi-line 2 use the communication profile "DP" Decentralized Periphery

3.1.2 Transmission speed and range

Transmission speeds between 9.6 kbit/sec and 1500 kbit/sec are available.

Baud rate (kbit/s)	9.6	19.2	93.75	187.5	500	1500
Range/segment	1200m	1200m	1200m	1000m	400m	200m

Up to 32 stations (master or slaves) can be connected in one segment.
The baud rate is automatically identified by multi-line 2

3.1.3 Configuration and the GSD file

The GSD file "deif0632.gsd" and "deif0632.dib" are on the included CD. They are to be copied in the subpaths *GSD* and *BITMAPS* of COM PROFIBUS. Then the PROFIBUS network is ready to be configured.
The station address is set in menu 4050 on multi-line.

3.1.4 Data in/out

61 words input and 13 words output are used.
Data in is the input data from multi-line 2 to master.
Data out is the output data from PROFIBUS master to multi-line 2.

3.2 Data tables

3.2.1 Measurement table (input data)

Address	Content	Type
0	Reserved	
1	Reserved	
2	Reserved	
3		Application version
4	U_{L1-L2}	Generator voltage. Measured in [V]
5	U_{L2-L3}	Generator voltage. Measured in [V]
6	U_{L3-L1}	Generator voltage. Measured in [V]
7	U_{L1-N}	Generator voltage. Measured in [V]
8	U_{L2-N}	Generator voltage. Measured in [V]
9	U_{L3-N}	Generator voltage. Measured in [V]
10	F_{GEN}	Generator frequency. Measured in [Hz/100]
11	I_{L1}	Generator current. Measured in [A]
12	I_{L2}	Generator current. Measured in [A]
13	I_{L3}	Generator current. Measured in [A]
14	Cos-phi	-99...0...100 Generator cosinus-phi. Measured in cos-phi:100 Negative value means capacitive cos-phi
15	P_{GEN}	Generator active power. Measured in [W]. Negative value means reverse power
16	Q_{GEN}	Generator reactive power. Measured in [var]. Positive value means generated inductive reactive power
17	$U_{BBL1-L2}$	Busbar. Measured in [V]

Address	Content	Type
18	F_{BB}	Busbar frequency L1. Measured in [Hz/100]
19 [HI]	Exp. U_{GEN}	Exponent generator voltage
19 [LO]	Exp. I_{GEN}	Exponent generator current
20 [HI]	Exp. P/Q_{GEN}	Exponent generator power/reactive power
20 [LO]	Exp. U_{BB}	Exponent busbar voltage
21 [HI] 22 [LO]	E_{GEN}	Energy counter. Measured in [kWh]. Max. 300000MWh
23	Alarms	Bit 0 1010. U-BB High step 1 Bit 1 1020. U-BB High step 2 Bit 2 1030. U-BB Low step 1 Bit 3 1040. U-BB Low step 2 Bit 4 1050. f-BB High step 1 Bit 5 1060. f-BB High step 2 Bit 6 1070. f-BB Low step 1 Bit 7 1080. f-BB Low step 2 Bit 8 1090. Reverse power Bit 9 1100. High current step 1 Bit 10 1110. High current step 2 Bit 11 1120. High power step 1 Bit 12 1130. High power step 2 Bit 13 1220. Unbalance current Bit 14 1230. Unbalance voltage
24	Alarms	Bit 0 1240. Q import Bit 1 1250. Q export Bit 2 1260. df/dt Bit 3 1270. Vector jump Bit 4 2060. GB sync. fail. Bit 5 4220. Supply alarm Bit 6 GB close fail. Bit 7 GB open fail. Bit 8 GB position feedback fail. Bit 9 Phase sequence error Bit 10 2070. MB sync. fail. Bit 11 MB close fail. Bit 12 MB open fail. Bit 13 MB position feedback fail. Bit 14 4390. Generator voltage/frequency fail. Bit 15 Tacho fail.
25	Alarms	Bit 0 1310. U-DG High step 1 Bit 1 1320. U-DG High step 2 Bit 2 1330. U-DG Low step 1 Bit 3 1340. U-DG Low step 2 Bit 4 1350. f-DG High step 1 Bit 5 1360. f-DG High step 2 Bit 6 1370. f-DG Low step 1 Bit 7 1380. f-DG Low step 2 Bit 8 1520. Fast overcurr. Bit 9 1530. High overcurr. Bit 13 4370. Start fail. Bit 14 Ramp down fail. Bit 15 4410. Stop fail.
26	Alarms engine interface	Bit 0 1400. 4-20mA in No. 1 Bit 1 1410. 4-20mA in No. 2 Bit 2 1420. 4-20mA in No. 3 Bit 3 1430. 4-20mA in No. 4 Bit 4 1440. PT100 No. 1 Bit 5 1450. PT100 No. 2 Bit 6 1460. Tacho Bit 9 1490. Dig. input No. 8 Bit 10 1500. Dig. input No. 9 Bit 11 1510. Dig. input No. 10

Address	Content	Type
27	Alarms analogue input and digital input	Bit 0 1800. 4-20mA in No. 5 Bit 1 1810. 4-20mA in No. 6 Bit 2 1820. 4-20mA in No. 7 Bit 3 1830. 4-20mA in No. 8 Bit 4 1600. Dig. input No. 11 Bit 5 1610. Dig. input No. 12 Bit 6 1620. Dig. input No. 13 Bit 7 1630. Dig. input No. 14 Bit 8 1640. Dig. input No. 15 Bit 9 1650. Dig. input No. 16 Bit 10 1660. Dig. input No. 17
28	Alarms load share	Bit 0 1670. Dig. input No. 18 Bit 1 1680. Dig. input No. 19 Bit 2 1690. Dig. input No. 20 Bit 3 1700. Dig. input No. 21 Bit 4 1710. Dig. input No. 22 Bit 5 1720. Dig. input No. 23 Bit 6 1730. Dig. input No. 24 Bit 7 1740. Dig. input No. 25 Bit 8 1750. Dig. input No. 26 Bit 9 1760. Dig. input No. 27 Bit 10 1770. Dig. input No. 28 Bit 11 1780. Dig. input No. 29 Bit 12 1790. Dig. input No. 30
29	Status	Bit 0 GB pos. on Bit 1 MB pos. on Bit 2 Alarm inhibit Bit 3 Running Bit 4 DG voltage/frequency OK Bit 5 Mains failure Bit 6 Auto mode
30		Number of alarms
31		Number of unacknowledged alarms
32	U_{DG-max}	Generator max. voltage. Measured in [V]
33	U_{DG-min}	Generator min. voltage. Measured in [V]
34	$U_{BBL2-L3}$	Busbar voltage. Measured in [V]
35	$U_{BBL3-L1}$	Busbar voltage. Measured in [V]
36	U_{BB-max}	Busbar max. voltage. Measured in [V]
37	U_{BB-min}	Busbar min. voltage. Measured in [V]
38	U_{BBL1-N}	Busbar voltage. Measured in [V]
39	U_{BBL2-N}	Busbar voltage. Measured in [V]
40	U_{BBL3-N}	Busbar voltage. Measured in [V]
41		Analog input engine interface No. 4 (scaled)
42		RPM
43	S_{GEN}	Generator seeming power. Measured in [VA]
44	PHI_{L1-L2}	0...359 Generator phase angle. Measured in [deg]
45	PHI_{L2-L3}	0...359 Generator phase angle. Measured in [deg]
46	PHI_{L3-L1}	0...359 Generator phase angle. Measured in [deg]
47	$PHI_{BBL3-L1}$	0...359 Busbar phase angle. Measured in [deg]
48	$PHI_{BBL1-DGL1}$	0...359 Busbar/generator phase angle. Measured in [deg]
49	df/dt_{BB-L1}	df/dt [Hz/100/s]
50	U_{SUPPLY}	Supply voltage. Measured in [V/10]
51	PT100	-40 – 250 temperature in deg. (engine interface)
52	PT100	-40 – 250 temperature in deg. (engine interface)
53		Control register table address 0

Address	Content	Type
54		Control register table address 1
55		Control register table address 3
56		Control register table address 4
57		Reserved
58		Analog input engine interface No. 1 (scaled)
59		Analog input engine interface No. 2 (scaled)
60		Analog input engine interface No. 3 (scaled)

3.2.2 Control register table (output data)

Address	Content	Description
0	Reserved	Write 0
1	Reserved	Write 0
2	Reserved	Write 0
3	Power regulator set-point	0...100% of nominal power Activated in menu 4041
4	PF regulator set-point	60...100 stated as PF value/100. The value 100 means PF = 1 Activated in menu 4045
5	Control command	Bit 0 This bit must be 1 when writing the command word If the bit is 0, the control command is don't care Bit 1 Start Bit 2 GB on Bit 3 GB off Bit 4 Stop Bit 5 MB on Bit 6 MB off Bit 7 Bit 8 Bit 9 Bit 10 Alarm ack. All bits are automatically reset in the AGC
6	Frequency regulator set-point	-50...50Hz/10. Based on nominal frequency Activated in menu 4042
7	Voltage regulator set-point	-100...100%/10 of nominal voltage Activated in menu 4043
8		

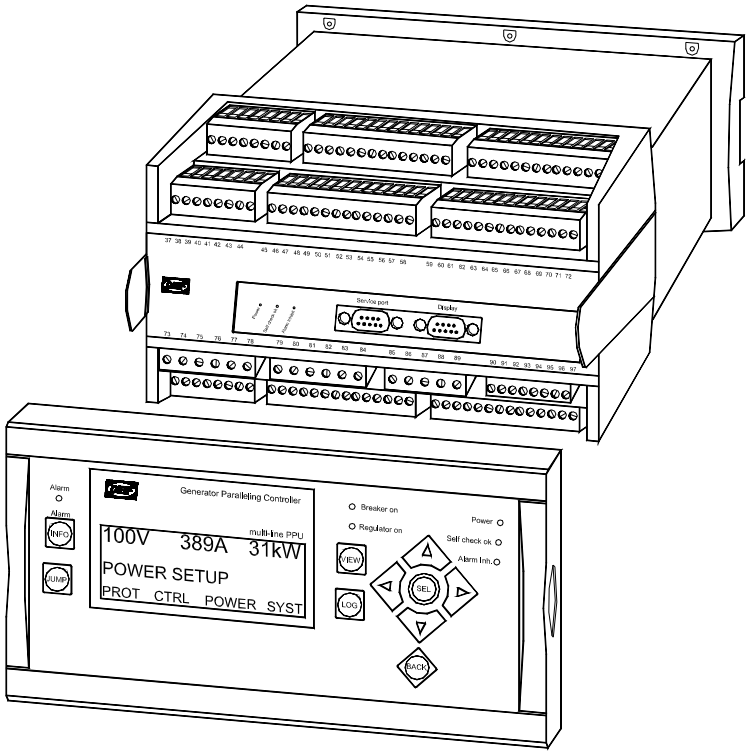
In menu 4040 it is selected, if a set-point is to be controlled by the control registers.
The content of the control registers is not lost in case of supply failure, so frequent updates are not necessary.

Example how to control the frequency via the Modbus:

- Activate frequency control register in menu 4042
- Write in the control register address 3 the desired frequency offset

NOTE:
Be aware that all addresses must include a legal value even though the control function is not used. E.g. in address 4 it is still necessary to write a value between 60 and 100 also when not running in power factor mode.

4 Caterpillar® CCM protocol (option H4)

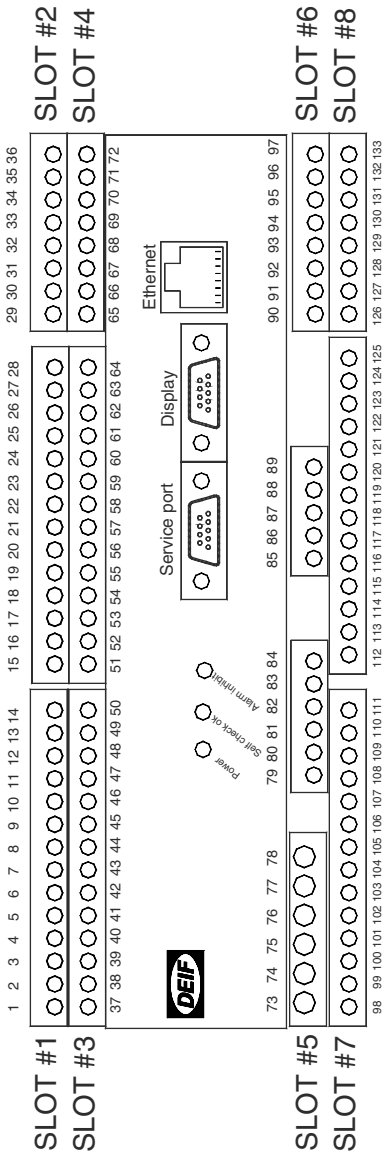


- *CCM protocol*
- *Hardware description*
- *Settings*

4.1 Hardware

The multi-line 2 Can open communication is carried out using a plug-in printed circuit board. The board is placed in slot #8 (terminals 126-133).

An overview of the terminals can be seen below. The slots are positioned in the unit as follows (seen from the top of the unit):

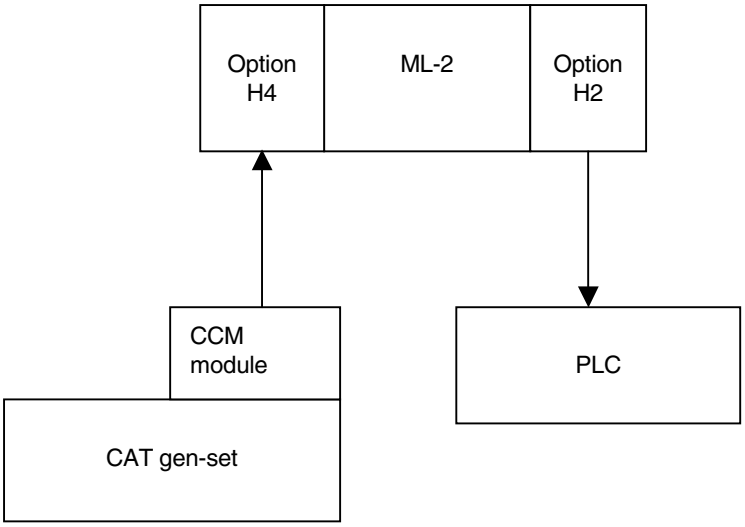


4.1.1 Slot #8, Caterpillar® CCM communication

Term.	Function	Description
126	Not used	
127	Not used	
128	RxD	RS232 receive data from other unit
129	Not used	
130	TxD	RS232 transmit data from multi-line
131	Not used	
132	GND	Ground
133	Not used	

4.2 Wirings

Principle:



4.3 Menu settings

4.3.1 Caterpillar® CCM setup

It is possible to change the parameters used in the communication between the multi-line 2 and the CCM. The parameters can be changed via the utility software or by menus 4770-4930 in the system menu.

The parameters which can be changed are:

Baud:	Set the baud rate to 9600 or 19200, default setting 9600 [1]
MID/unit:	The ID of the gen-set that the list corresponds to Default the ID is set to 36 (24 hex) for single gen-set, the value must be entered in decimal numbers
ACT:	Turn the list ON/OFF. Default all lists are turned OFF [2]
Rate:	This time setting indicates how often the CCM must return an update of the data Default the update time is set to 2 sec [3]

NOTE:
[1] Note that some CCMs can only use 9600 baud.
[2] Note that only the new CCM can use more than 8 lists. When using an old CCM, be sure that lists 9-16 are turned off.
[3] Note that the CCM can provide a maximum of 50 parameters per second.

4.4 Cat CCM communication

4.4.1 Protocol specification

In the H4 a part of the M5X protocol is implemented to make it possible to communicate with Caterpillar's Customer Communication Module (CCM). The H4 option offers to collect up to 64 parameters in the first 8 lists; the parameters collected from the CCM are placed in Modbus.

The H4 will create the lists in the CCM and collect the data when it is broadcasted from the CCM, this is done via the implementation of some of the M5X protocol functions, Instruction Identifier: IID $10, IID $11, IID $12 and IID $13 are implemented.

If no changes are made the lists will consist of the default PIDs which are shown in the table below. When the lists are turned on, the CCM will start to return the data for the PIDs to the multi-line 2 and here the values are stored in Modbus. The values which the CCM transmits for every PID will be placed in the Modbus register corresponding to the PID.

Example:
Use of the default PID list:

The system battery voltage PID F013 is defined as PID #7 (list 1), the value that the CCM returns might be 48, this value will be placed in Modbus register 18506. This PID has a resolution of 0.5 V per bit, the master system which reads the value can calculate the voltage to 0.5 * Modbus register (18506) = 24 V in this example.

4.4.2 Default lists #1 - #8

List #	PID #	Default PID in Hex	Description	Input PID at Modbus register:	Output value at Modbus register:
1	1	00 03	Detonation	17500	18500
	2	00 15	Throttle position	17501	18501
	3	00 40	Generator set engine RPM	17502	18502
	4	00 44	Engine coolant temperature	17503	18503
	5	00 46	Desired engine speed	17504	18504
	6	00 54	Engine oil pressure	17505	18505
	7	F0 13	System battery voltage	17506	18506
	8	F0 E8	Engine coolant pump pressure status	17507	18507
2	9	F1 13	Engine operation	17508	18508
	10	F1 18	Engine load factor	17509	18509
	11	F1 89	Engine power derate percentage	17510	18510
	12	F1 D0	Jacket water outlet to engine oil differential temperature	17511	18511
	13	F4 0E	Engine oil filter differential pressure	17512	18512
	14	F4 4C	Generator set relay status	17513	18513
	15	F4 4E	Actual exhaust oxygen	17514	18514
	16	00 00	Empty	17515	18515
3	17	F4 4F	Desired oxygen	17516	18516
	18	F4 60	Engine alarm status	17517	18517
	19	F4 6D	Cooldown time remaining	17518	18518
	20	F4 8D	Engine coolant pressure (absolute)	17519	18519
	21	F4 EA	Unfiltered engine oil pressure (gauge)	17520	18520
	22	F5 0E	Engine fuel pressure (absolute)	17521	18521
	23	F5 11	Intake manifold air temperature	17522	18522
	24	F5 12	Actual air/fuel ratio	17523	18523
4	25	F5 1A	Fuel quality	17524	18524
	26	F5 1D	Fuel temperature	17525	18525

List #	PID #	Default PID in Hex	Description	Input PID at Modbus register:	Output value at Modbus register:
	27	F5 1E	Intake manifold air flow	17526	18526
	28	F5 24	Desired exhaust oxygen at full load	17527	18527
	29	F5 3E	Engine oil temperature	17528	18528
	30	F5 8E	Gas fuel flow	17529	18529
	31	F5 b1	Gas specific gravity	17530	18530
	32	F5 BA	Inlet manifold air pressure	17531	18531
5	33	F5 97	Engine average exhaust port temperature	17532	18532
	34	F5 5D	Right bank average exhaust port temperature	17533	18533
	35	F5 5C	Left bank average exhaust port temperature	17534	18534
	36	F5 93	Right bank turbine inlet temperature	17535	18535
	37	F5 95	Right bank turbine outlet temperature	17536	18536
	38	F5 94	Left bank turbine inlet temperature	17537	18537
	39	F5 96	Left bank turbine outlet temperature	17538	18538
	40	00 00	Empty	17539	18539
6	41	F4 30	Cylinder #1 exhaust port temperature	17540	18540
	42	F4 31	Cylinder #2 exhaust port temperature	17541	18541
	43	F4 32	Cylinder #3 exhaust port temperature	17542	18542
	44	F4 33	Cylinder #4 exhaust port temperature	17543	18543
	45	F434	Cylinder #5 exhaust port temperature	17544	18544
	46	F435	Cylinder #6 exhaust port temperature	17545	18545
	47	F436	Cylinder #7 exhaust port temperature	17546	18546
	48	F437	Cylinder #8 exhaust port temperature	17547	18547
7	49	F438	Cylinder #9 exhaust port temperature	17548	18548
	50	F439	Cylinder #10 exhaust port temperature	17549	18549
	51	F43A	Cylinder #11 exhaust port temperature	17550	18550
	52	F43B	Cylinder #12 exhaust port temperature	17551	18551
	53	F43C	Cylinder #13 exhaust port temperature	17552	18552
	54	F43D	Cylinder #14 exhaust port temperature	17553	18553
	55	F43E	Cylinder #15 exhaust port temperature	17554	18554
	56	F43F	Cylinder #16 exhaust port temperature	17555	18555
8	57	F598	Cylinder #17 exhaust port temperature	17556	18556
	58	F599	Cylinder #18 exhaust port temperature	17557	18557
	59	F59A	Cylinder #19 exhaust port temperature	17558	18558
	60	F59B	Cylinder #20 exhaust port temperature	17559	18559
	61	00 00	Empty	17560	18560
	62	00 00	Empty	17561	18561
	63	00 00	Empty	17562	18562
	64	00 00	Empty	17563	18563

4.4.3 Default lists #9 - #16

While the old CCM can only handle 8 lists, the new CCM 01-10-2002 has the ability to use up to 16 lists of 8 PIDs.

The new CCM which is used on NES (New Engine System), has the possibility to use PIDs consisting of 3 bytes; these PIDs' MSB (Most Significant Byte) has a hex value between D0 and D4. This type of PIDs can only be used in lists 9-16, the two MSB must be placed in the first Modbus register, and the LSB must be placed in the "space for extra PID byte". If 3 bytes PIDs are not used, "space for extra PID byte" must be 0.

Example:

List #	PID #	Default PID in Hex	Description	Input PID at Modbus register:	Output value at Modbus register:
9	65	D0 01	Fuel valve differential pressure	17564	18564
		00 0A	Space for extra PID byte	17565	

To place the PID D0 01 0A (fuel valve differential pressure) as the first PID in list 9 (PID #65), D0 01 must be written to Modbus register (17564), and 0A must be written to Modbus register (17565).

List #	PID #	Default PID in Hex	Description	Input PID at Modbus register:	Output value at Modbus register:
9	65	D0 00	Cylinder #1 detonation level	17564	18564
		00 20	Space for extra PID byte	17565	
	66	D0 00	Cylinder #2 detonation level	17566	18565
		00 21	Space for extra PID byte	17567	
	67	D0 00	Cylinder #3 detonation level	17568	18566
		00 22	Space for extra PID byte	17569	
	68	D0 00	Cylinder #4 detonation level	17570	18567
		00 23	Space for extra PID byte	17571	
	69	D0 00	Cylinder #5 detonation level	17572	18568
		00 24	Space for extra PID byte	17573	
	70	D0 00	Cylinder #6 detonation level	17574	18569
		00 25	Space for extra PID byte	17575	
	71	D0 00	Cylinder #7 detonation level	17576	18570
		00 26	Space for extra PID byte	17577	
	72	D0 00	Cylinder #8 detonation level	17578	18571
		00 27	Space for extra PID byte	17579	
10	73	D0 00	Cylinder #1 ignition timing	17580	18572
		00 40	Space for extra PID byte	17581	
	74	D0 00	Cylinder #2 ignition timing	17582	18573
		00 41	Space for extra PID byte	17583	
	75	D0 00	Cylinder #3 ignition timing	17584	18574
		00 42	Space for extra PID byte	17585	
	76	D0 00	Cylinder #4 ignition timing	17586	18575
		00 43	Space for extra PID byte	17587	
	77	D0 00	Cylinder #5 ignition timing	17588	18576
		00 44	Space for extra PID byte	17589	
	78	D0 00	Cylinder #6 ignition timing	17590	18577
		00 45	Space for extra PID byte	17591	
	79	D0 00	Cylinder #7 ignition timing	17592	18578
		00 46	Space for extra PID byte	17593	

List #	PID #	Default PID in Hex	Description	Input PID at Modbus register:	Output value at Modbus register:
	80	D0 00	Cylinder #8 ignition timing	17594	18579
		00 47	Space for extra PID byte	17595	
11	81	D0 00	Cylinder #1 transformer secondary output voltage percentage	17596	18580
		00 EB	Space for extra PID byte	17597	
	82	D0 00	Cylinder #2 transformer secondary output voltage percentage	17598	18581
		00 EC	Space for extra PID byte	17599	
	83	D0 00	Cylinder #3 transformer secondary output voltage percentage	17600	18582
		00 ED	Space for extra PID byte	17601	
	84	D0 00	Cylinder #4 transformer secondary output voltage percentage	17602	18583
		00 EE	Space for extra PID byte	17603	
	85	D0 00	Cylinder #5 transformer secondary output voltage percentage	17604	18584
		00 EF	Space for extra PID byte	17605	
	86	D0 00	Cylinder #6 transformer secondary output voltage percentage	17606	18585
		00 F0	Space for extra PID byte	17607	
	87	D0 00	Cylinder #7 transformer secondary output voltage percentage	17608	18586
		00 F1	Space for extra PID byte	17609	
	88	D0 00	Cylinder #8 transformer secondary output voltage percentage	17610	18587
		00 F2	Space for extra PID byte	17611	
12	89	D0 00	Cylinder #9 detonation level	17612	18588
		00 28	Space for extra PID byte	17613	
	90	D0 00	Cylinder #10 detonation level	17614	18589
		00 29	Space for extra PID byte	17615	
	91	D0 00	Cylinder #11 detonation level	17616	18590
		00 2A	Space for extra PID byte	17617	
	92	D0 00	Cylinder #12 detonation level	17618	18591
		00 2B	Space for extra PID byte	17619	
	93	D0 00	Cylinder #13 detonation level	17620	18592
		00 2C	Space for extra PID byte	17621	
	94	D0 00	Cylinder #14 detonation level	17622	18593
		00 2D	Space for extra PID byte	17623	
	95	D0 00	Cylinder #15 detonation level	17624	18594
		00 2E	Space for extra PID byte	17625	
	96	D0 00	Cylinder #16 detonation level	17626	18595
		00 2F	Space for extra PID byte	17627	
13	97	D0 00	Cylinder #9 ignition timing	17628	18596
		00 48	Space for extra PID byte	17629	
	98	D0 00	Cylinder #10 ignition timing	17630	18597
		00 49	Space for extra PID byte	17631	

List #	PID #	Default PID in Hex	Description	Input PID at Modbus register:	Output value at Modbus register:
	99	D0 00	Cylinder #11 ignition timing	17632	18598
		00 4A	Space for extra PID byte	17633	
	100	D0 00	Cylinder #12 ignition timing	17634	18599
		00 4B	Space for extra PID byte	17635	
	101	D0 00	Cylinder #13 ignition timing	17636	18600
		00 4C	Space for extra PID byte	17637	
	102	D0 00	Cylinder #14 ignition timing	17638	18601
		00 4D	Space for extra PID byte	17639	
	103	D0 00	Cylinder #15 ignition timing	17640	18602
		00 4E	Space for extra PID byte	17641	
	104	D0 00	Cylinder #16 ignition timing	17642	18603
		00 4F	Space for extra PID byte	17643	
14	105	D0 00	Cylinder #9 transformer secondary output voltage percentage	17644	18604
		00 F3	Space for extra PID byte	17645	
	106	D0 00	Cylinder #10 transformer secondary output voltage percentage	17646	18605
		00 F4	Space for extra PID byte	17647	
	107	D0 00	Cylinder #11 transformer secondary output voltage percentage	17648	18606
		00 F5	Space for extra PID byte	17649	
	108	D0 00	Cylinder #12 transformer secondary output voltage percentage	17650	18607
		00 F6	Space for extra PID byte	17651	
	109	D0 00	Cylinder #13 transformer secondary output voltage percentage	17652	18608
		00 F7	Space for extra PID byte	17653	
	110	D0 00	Cylinder #14 transformer secondary output voltage percentage	17654	18609
		00 F8	Space for extra PID byte	17655	
	111	D0 00	Cylinder #15 transformer secondary output voltage percentage	17656	18610
		00 F9	Space for extra PID byte	17657	
	112	D0 00	Cylinder #16 transformer secondary output voltage percentage	17658	18611
		00 FA	Space for extra PID byte	17659	
15	113	D0 00	Cylinder #17 detonation level	17660	18612
		00 30	Space for extra PID byte	17661	
	114	D0 00	Cylinder #18 detonation level	17662	18613
		00 31	Space for extra PID byte	17663	
	115	D0 00	Cylinder #19 detonation level	17664	18614
		00 32	Space for extra PID byte	17665	
	116	D0 00	Cylinder #20 detonation level	17666	18615
		00 33	Space for extra PID byte	17667	
	117	D0 00	Cylinder #17 ignition timing	17668	18616
		00 50	Space for extra PID byte	17669	

List #	PID #	Default PID in Hex	Description	Input PID at Modbus register:	Output value at Modbus register:
	118	D0 00	Cylinder #18 ignition timing	17670	18617
		00 51	Space for extra PID byte	17671	
	119	D0 00	Cylinder #19 ignition timing	17672	18618
		00 52	Space for extra PID byte	17673	
	120	D0 00	Cylinder #20 ignition timing	17674	18619
		00 53	Space for extra PID byte	17675	
16	121	D0 00	Cylinder #17 transformer secondary output voltage percentage	17676	18620
		00 FB	Space for extra PID byte	17677	
	122	D0 00	Cylinder #18 transformer secondary output voltage percentage	17678	18621
		00 FC	Space for extra PID byte	17679	
	123	D0 00	Cylinder #19 transformer secondary output voltage percentage	17680	18622
		00 FD	Space for extra PID byte	17681	
	124	D0 00	Cylinder #20 transformer secondary output voltage percentage	17682	18623
		00 FE	Space for extra PID byte	17683	
	125	D0 01	Fuel valve position	17684	18624
		00 09	Space for extra PID byte	17685	
	126	D0 01	Fuel valve differential pressure	17686	18625
		00 0A	Space for extra PID byte	17687	
	127	00 00	Empty	17688	18626
		00 00	Empty	17689	
	128	00 00	Empty	17690	18627
		00 00	Empty	17691	

4.4.4 Customized lists

It is possible to change the PIDs if desired, the PIDs in all the lists are determined by the value in the Modbus register corresponding to the PID. This means that the 8 PIDs in list 1 are determined by the values in Modbus register 17500-17507.

Example 1:
If the only parameter of interest is the engine RPM:

The PID for RPM (40 hex) must be written to Modbus register 17500, and 0 must be written to the rest of the PIDs in list #1. Note that the CCM ignores any PIDs in a list which comes after a PID = 0.

The update rate of list 1 can be set to the minimum value of 0.5 sec, then a new RPM value can be read at Modbus register 18500 every ½ second.

List #	PID #	Default PID in Hex	Description	Input PID at Modbus register:	Output value at Modbus register:
1	1	00 40	Generator set engine RPM	17500	18500
	2	00 00		17501	18501
	3	00 00		17502	18502
	4	00 00		17503	18503
	5	00 00		17504	18504
	6	00 00		17505	18505
	7	00 00		17506	18506
	8	00 00		17507	18507

Example 2:
Change a PID in list #2:

To place the engine RPM (PID 40 hex) as the second PID in list 2, PID #10, 40 hex must be written to Modbus register 17509. Then the RPM returned from the CCM can be read from the Modbus register 18509.

List #	PID #	Default PID in Hex	Description	Input PID at Modbus register:	Output value at Modbus register:
2	9	F1 13	Engine operation	17508	18508
	10	**00 40**	**Generator set engine RPM**	**17509**	**18509**
	11	F1 89	Engine power derate percentage	17510	18510
	12	F1 D0	Jacket water outlet to engine oil differential temperature	17511	18511
	13	F4 0E	Engine oil filter differential pressure	17512	18512
	14	F4 4C	Generator set relay status	17513	18513
	15	F4 4E	Actual exhaust oxygen	17514	18514
	16	00 00	Empty	17515	18515

NOTE:
When a list is being changed, it must be turned off and then turned on again after the setup. Refer to chapter 4.4.1.

WARNING:
If just one of the PIDs in a list is not a correct request for this engine/EMC type, the CCM will stop the whole list from being transmitted. For example, if one of the PIDs in list #1 is the request for “Cylinder #20 exhaust port temperature”, and this is asked from a 16 cylinder engine, then no values will be returned for list #1.